PATENT ABSTRACTS OF JAPAN

(11)Publication number : 2003-066443
(43)Date of publication of application : 05.03.2003

(51)Int.Cl. G02F 1/13357
F21V 8/00
G02B 5/02
G02F 1/1335
G09F 9/00
G09F 9/30
G09F 9/35
// F21Y103:00

(21)Application number : 2001-251282
(22)Date of filing : 22.08.2001

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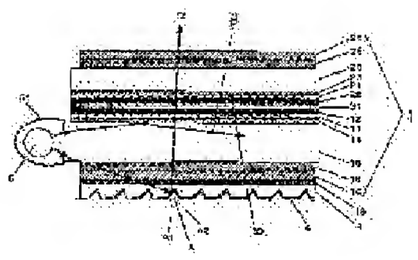
(54) LIQUID CRYSTAL DISPLAY DEVICE



(57)Abstract:
PROBLEM TO BE SOLVED: To provide a self-illuminative and outside light-illuminative (dually illuminative) liquid crystal display device provided with a translucent and reflective layer, which is made so thin and lightweight that it is difficult to be achieved in the case of the liquid crystal display device having a side light type light guide plate and has excellent display quality.
SOLUTION: This liquid crystal display device has a liquid crystal display panel (1) provided with at least a liquid crystal cell formed by interposing a liquid crystal (30) between a rear side substrate and a visible side substrate. The rear side substrate is prepared by forming at least a transparent layer (14) having a refractive index lower than that of a transparent substrate (10) and the translucent and reflective layer (11) for transmitting and reflecting light on the substrate (10). The visible side substrate is prepared by forming a transparent electrode (21) on another transparent substrate (20). These substrates are arranged so that the electrode sides of them are made opposite to each other. This display device has also illuminators (5) arranged on one or more side faces of the panel (1) and an optical path controlling layer (4) having the refractive index higher than that of the layer (14) and a plurality of optical path changing slopes (A1) which are formed on the outside of the rear side substrate and each of which has 35-48° angle of inclination with respect to the reference plane of the rear side substrate.

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[Date of request for examination]
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[Kind of final disposal of application other than the examiner's decision of rejection or

application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

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[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] The tooth-back side substrate which has at least the transflective reflection layer which penetrates the clear layer of a low refractive index, and light to a transparence substrate rather than the substrate, and is reflected in it, It has a lighting system on 1 or two or more side faces in the liquid crystal display panel which possesses at least the liquid crystal cell which comes to pinch liquid crystal while making the check-by-looking side substrate which has a transparent electrode in a transparence substrate counter and having arranged those electrode side for it. And the liquid crystal display characterized by coming to prepare an optical-path control layer with a refractive index higher than the clear layer of said low refractive index while having the plurality of the optical-path conversion slant face whose tilt angle to the base plane of the substrate is 35 - 48 degrees on the outside of said tooth-back side substrate.

[Claim 2] The liquid crystal display with which the clear layer of a low refractive index is located between a transparence substrate and a transflective reflection layer, and the transflective reflection layer serves as an electrode in claim 1.

[Claim 3] the transflective reflection layer which has a concavo-convex type light-scattering side through the clear layer of a low refractive index in claim 1 on the transparence substrate which forms a tooth-back side substrate -- having -- and the transflective reflection layer top -- a front face -- the liquid crystal display which has a transparent electrode through a smooth transparence insulating layer.
[Claim 4] The liquid crystal display which has a light reflex layer on the outside of an optical-path control layer in claims 1-3.
[Claim 5] The liquid crystal display which is that in which a light reflex layer has a metal thin film at least in claim 4.
[Claim 6] The liquid crystal display which a light reflex layer consists of what prepared the metal thin film in the bright film at least in claim 5, and it comes to paste an optical-path control layer with the adhesion means of a refractive index with the light reflex layer smaller than an optical-path control layer.
[Claim 7] The liquid crystal display whose refractive-index difference of the transparence substrate which forms a tooth-back side substrate in claims 1-6, and the clear layer of a low refractive index is 0.05 or more.
[Claim 8] The liquid crystal display with which the transparence substrate of a liquid crystal cell which forms a tooth-back side substrate at least consists of an isotropic ingredient optically in claims 1-7.
[Claim 9] The liquid crystal display with which a liquid crystal display panel has a polarizing plate on one side or the both sides of a liquid crystal cell in claims 1-8.
[Claim 10] The liquid crystal display with which a liquid crystal display panel has a phase contrast plate more than one layer or two-layer between a liquid crystal cell and a polarizing plate in claim 9.
[Claim 11] The liquid crystal display which consists of plurality of prism-like irregularity which possesses the optical-path conversion slant face in the condition that an optical-path control layer meets a lighting system, in claims 1-10.
[Claim 12] The liquid crystal display with which the prism-like irregularity of an optical-path control layer consists of a crevice of a cross-section triangle in claim 11.
[Claim 13] The liquid crystal display with which a prism-like crevice becomes the side face of the liquid crystal display panel which has arranged the lighting system from the continuation slot ranging from the end to the other end of an optical-path control layer in claim 12 in the direction of a ridgeline which is parallel, and which carried out ****

dip.
[Claim 14] The liquid crystal display whose die length of the slot a prism-like crevice consists of a discontinuous slot in claim 12, and is 5 or more times of the depth.
[Claim 15] The liquid crystal display in the condition of it having been parallel or having inclined in claim 14 with the side face of a liquid crystal display panel in which the die-length direction of the discontinuous slot of a prism-like crevice has arranged the lighting system.
[Claim 16] The liquid crystal display which consists of the crevice or heights of the cross-section triangle which has the 2nd page of the optical-path conversion slant face where it comes to have a lighting system on two side faces in which a liquid crystal display panel counters on, and the prism-like irregularity of an optical-path control layer meets the lighting system in claim 11, or a cross-section square.
[Claim 17] The liquid crystal display whose tilt angle concerned of an optical-path conversion slant face [in / on claims 1-16 and / an optical-path control layer] is 38 - 45 degrees.
[Claim 18] The liquid crystal display which it comes to paste a liquid crystal display panel by an optical-path control layer consisting of a transparence sheet in claims 1-17 through the glue line of a refractive index higher than the clear layer of the low refractive index concerned.
[Claim 19] The liquid crystal display with which a glue line consists of an adhesive layer in claim 18.
[Claim 20] The liquid crystal display whose refractive index of an optical-path control layer and a glue line is [0.05 or more] higher than the clear layer of the low refractive index concerned in claims 1-19.
[Claim 21] The liquid crystal display with which it comes to arrange [a lighting system] the side face which a tooth-back side substrate forms in claims 1-20 rather than the side face which a check-by-looking side substrate forms to the projection side face of the tooth-back side substrate to a projection.
[Claim 22] The liquid crystal display which comes to carry out arrangement maintenance on the side face of a tooth-back side substrate by the method which a lighting system is surrounded with the light source holder of a light reflex mold, and is pasted up on the edge of the vertical side of a tooth-back side substrate through the edge of the light source holder in claims 1-21.
[Claim 23] The liquid crystal display with which it comes to form the

circuit for liquid crystal actuation between the clear layer of a low refractive index, and a transflective reflection layer in claims 1-22.

[Translation done.]

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1.This document has been translated by computer. So the translation may not reflect the original precisely.
2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to the liquid crystal display of the lighting and the mold both for outdoor daylight which is excellent in display grace with the easy formation of thin lightweight.
[0002]
[Background of the Invention] The liquid crystal display of the lighting and the mold both for outdoor daylight which contains transflective reflection layers, such as a half mirror, has spread widely as pocket mold devices, such as a pocket personal computer and a cellular phone, etc. By this pocket mold device, in order to raise the portability further, lightweight-ization by a miniaturization, thin-shape-izing, etc. is called for strongly. However, even if it uses the side light type light guide plate which compares to the back light which enables a check by looking with lighting mode, and is excellent in thinness in the former, it is the actual condition that the thickness usually turns into thickness of 2mm or more, and thin lightweight-ization of the whole equipment serves as a limitation mostly.
[0003]
[The technical technical problem of invention] In a side light mold light guide plate, this invention can realize difficult thin lightweight[achievement]-ization, and makes a technical problem development of the liquid crystal display of the lighting and the mold both for outdoor daylight of good transflective reflection layer

possession also for display grace.
[0004]
[Means for Solving the Problem] The tooth-back side substrate which has at least the transflective reflection layer which this invention penetrates the clear layer of a low refractive index, and light rather than the substrate to a transparence substrate, and is reflected, It has a lighting system on 1 or two or more side faces in the liquid crystal display panel which possesses at least the liquid crystal cell which comes to pinch liquid crystal while making the check-by-looking side substrate which has a transparent electrode in a transparence substrate counter and having arranged those electrode side for it. And while having the plurality of the optical-path conversion slant face whose tilt angle to the base plane of the substrate is 35 - 48 degrees on the outside of said tooth-back side substrate, the liquid crystal display characterized by coming to prepare an optical-path control layer with a refractive index higher than the clear layer of said low refractive index is offered.
[0005]
[Effect of the Invention] According to this invention, a back light device can be formed in the optical-path control layer which is excellent in side-face arrangement and the thinness of a lighting system. Transmitting efficiently the incident light from a liquid crystal cell substrate and the lighting system especially arranged on the panel side face using the tooth-back side substrate in the direction of a side face of opposite Through the optical-path control layer of arrangement, optical-path conversion is carried out efficiently and the transmission light can be used for the liquid crystal display in lighting mode at the check-by-looking side of a liquid crystal display panel at a tooth-back side. Moreover, the liquid crystal display of the lighting and the mold both for outdoor daylight which can also attain the liquid crystal display in outdoor daylight mode through a transflective reflection layer, is excellent in thinness and lightweight nature, is bright and is excellent in display grace can be obtained.
[0006] The above is because the clear layer of the low refractive index prepared in the tooth-back side substrate, the optical-path control layer of a slant-face reflective type, and the transflective reflection layer were used. That is, the incident light from a panel side face can be efficiently transmitted in the direction of a side face of opposite by the locked-in effect by the total reflection based on the clear layer of a low refractive index, the homogeneity of the brightness in the whole screen improves, and good display grace is attained. If there is

no clear layer of a low refractive index, it will be deficient in the transmission efficiency to back, and, as for ******, a screen will serve as a display to which it is hard to try to become dark from a lighting system.

[0007] On the other hand, the incident light thru/or its transmission light from a side face is reflected through the optical-path conversion slant face by the optical-path control layer, directivity can improve optical-path conversion, and thin shape-ization can also be attained. Said directive achievement is difficult in the scatter reflection method through a split face etc. Moreover, by having combined the optical-path control layer and the liquid crystal display panel, achievement can consider as a difficult very thin light emission gunner stage with the conventional side light type light guide plate. Incidentally 200 micrometers or less also of formation of an optical-path control layer 100 micrometers or less are also possible above all.

[0008] On the other hand, the liquid crystal display which makes the transmission and reflection factor balance and is excellent in brightness in both lighting mode and outdoor daylight mode with the activity of a transflective reflection layer can be attained.

[0009]

[Embodiment of the Invention] The tooth-back side substrate which has at least the transflective reflection layer which the liquid crystal display by this invention penetrates the clear layer of a low refractive index, and light rather than the substrate to a transparence substrate, and is reflected, It has a lighting system on 1 or two or more side faces in the liquid crystal display panel which possesses at least the liquid crystal cell which comes to pinch liquid crystal while making the check-by-looking side substrate which has a transparent electrode in a transparence substrate counter and having arranged those electrode side for it. And while having the plurality of the optical-path conversion slant face whose tilt angle to the base plane of the substrate is 35 - 48 degrees on the outside of said tooth-back side substrate, it comes to prepare an optical-path control layer with a refractive index higher than the clear layer of said low refractive index.

[0010] The example of the above mentioned liquid crystal display was shown in drawing 1 and drawing 2 . 1 is a liquid crystal display panel, 4 is an optical-path control layer, A1 is an optical-path conversion slant face, 10 is a transparence substrate by the side of a tooth back, and, also as for 11 and 11b serving as an electrode, for a certain transflective reflection layer, the transparence substrate by the side of the clear layer of a low refractive index and a check by looking of

20 of 14, and 21, liquid crystal, and 5 and 52 are [a transparent electrode and 30] lighting systems. In addition, for the orientation film, and 15 and 25, as for a phase contrast plate and 23, a polarizing plate, and 16 and 26 are [12 and 22 / a light filter and 6] light reflex layers.

[0011] The tooth-back side substrate which has at least the transflective reflection layer 11 which penetrates the clear layer 14 and light of a low refractive index to the transparence substrate 10 rather than the substrate, and is reflected in it like the example of drawing as a liquid crystal display panel 1 (10), The liquid crystal cell which comes to pinch liquid crystal 30 while making the check-by-looking side substrate (20) which has a transparent electrode 21 in the transparence substrate 20 counter and having arranged those electrode 11 and 21 side for it is provided at least. The proper thing which carries out outgoing radiation of the incident light from the tooth-back side which has arranged the optical-path control layer 4 from the check-by-looking side of another side as a display light through control by liquid crystal etc. can be used, and there is especially no definition about the class. In addition, 31 in drawing is a sealant for enclosing liquid crystal 30 among the transparence substrates 10 and 20.

[0012] As an example of the liquid crystal cell incidentally described above, the thing of the twist system like TN liquid crystal cell, a STN liquid crystal cell, a vertical orientation cel and a HAN cel, and an OCB cel, a non-twisting system, a guest host system, or a ferroelectric liquid crystal system, the thing using optical diffusion, etc. may be raised based on the orientation gestalt of liquid crystal, and an active matrix, the passive matrix method of the actuation method of liquid crystal, etc. may be proper.

[0013] A transparence substrate is used for the cel substrate by the side of a tooth back and a check by looking in order to enable transparency of the illumination light or display light. As for the transparence substrate, what consists of an isotropic ingredient optically is more desirable than the point of being able to form with proper ingredients, such as glass and resin, controlling a birefringence as much as possible above all, and reducing optical loss etc. Moreover, what is excellent in transparent and colorless nature like the alkali-free-glass plate to a blue glass plate is more desirable than points, such as brightness and improvement in display grace, and a resin substrate is still more desirable than points, such as lightweight nature.

[0014] As shown in drawing 1 as a polygonal-line arrow head beta by

preparing as a layer with a refractive index lower than the transparence substrate which forms the tooth-back side substrate, the clear layer of the low refractive index prepared in a tooth-back side substrate In case the incident light from a lighting system 5 is transmitted in the interior of the tooth-back side substrate 10, carry out total reflection of the transmission light through the refractive-index difference of a substrate 10 and a clear layer 14, and it shuts up efficiently in a tooth-back side substrate. This transmits said transmission light to the side-face side (back) of opposite efficiently, and transmission light is supplied with sufficient uniformity also to the optical-path conversion slant face A1 of the optical-path control layer 4 in a location distant from a lighting system. As shown as a polygonal-line arrow head alpha through the echo by the slant face, optical-path conversion is carried out and it aims at the homogeneous improvement in the brightness in the whole display screen.

[0015] Moreover, prevention of the aforementioned transmission light carrying out incidence of the clear layer of the above mentioned low refractive index to a liquid crystal layer, it receiving a birefringence and dispersion, and preventing and a display becoming dark and a display near the lighting system ghost-izing transmission light decreasing or ununiformity-izing by a transmission condition changing selectively, in back by that cause, and reducing display grace etc. carries out as the object. When the light filter etc. has furthermore been arranged, also let it be the object to prevent the rapid attenuation by the transmission absorption of light by it, and to avoid reduction of transmission light. At that to which the incident light from a lighting system is transmitted in the inside of a liquid crystal layer, transmission light is scattered about in a liquid crystal layer, it will be in an uneven transmission condition, ununiformity-izing and the ghost of outgoing radiation light are produced, and a display image does not see, but they are **** and a cone.

[0016] The clear layer of a low refractive index can be formed by the method with proper vacuum deposition method, spin coat method, etc. using the proper ingredient like the low refractive-index dielectric of for example, an inorganic system with a refractive index lower than the transparence substrate which forms a tooth-back side substrate, or an organic system, and there is especially no definition about the ingredient and formation approach. The refractive-index difference of a clear layer and a transparence substrate is so advantageous that it is large, and it is [0.05 or more] more desirable than points, such as transmission efficiency to the back by the above mentioned total

reflection, that it is especially 0.1-0.4 above all. With the refractive-index difference of this extent, the display grace by outdoor daylight mode is hardly influenced. When the refractive-index difference concerned is incidentally 0.1, the reflection factor of the outdoor daylight in the interface is 0.1% or less, and lowering of the brightness by the reflection loss or contrast is very small.

[0017] Although the arrangement location of the clear layer of a low refractive index can be determined suitably, it is more desirable than points, such as encroachment prevention to the above mentioned locked-in effect and above mentioned liquid crystal layer of transmission light, like the example of drawing that you make it located between the transparence substrate 10 and a transflective reflection layer 11. Moreover, when arranging a light filter between the transparence substrate 10 and a transflective reflection layer 11, it is more desirable than the point of preventing the transmission absorption-of-light loss by the light filter that you make it located in a substrate 10 side rather than the light filter. Therefore, the clear layer 14 of a low refractive index is usually formed in the tooth-back side substrate 10 directly. In that case, it is so advantageous to dispersion prevention of transmission light that a clear layer is therefore so smooth that the attachment side of the clear layer in a substrate is smooth, and desirable, and more desirable than the point of the effect prevention to display light. In addition, as for a light filter 23, in usually, it is more desirable than the aforementioned point like the example of drawing 1 that you make it located in the check-by-looking side substrate 20 side.

[0018] The thickness of the clear layer of a low refractive index is so more advantageous that it is thicker than the point of maintenance of the total reflection effectiveness than it may fade in the locked-in effect which is an undulatory stain and was described above by the phenomenon, if too thin. Although the thickness can be determined more suitably than points, such as the total reflection effectiveness, generally receive the light with a wavelength of 380-780nm. From points, such as the total reflection effectiveness over light with a wavelength [by the side of short wavelength] of 380nm, especially It is desirable that it is the thickness more than one wave (380nm) especially more than 1/2 wave (190nm) above all based on the optical path length computed by refractive-index x thickness more than quarter-wave length (95nm), and it is desirable that it is the thickness of 600 morenm or more.

[0019] About the thickness of the cel substrates 10 and 20 by the side of a tooth back and a check by looking, there is especially no

definition and it can be suitably determined according to the enclosure reinforcement of liquid crystal etc. Especially generally 50 micrometers - 2mm is cost by the thickness of 100 micrometers - 1mm above all 10 micrometers - 5mm from optical transmission effectiveness and points, such as balance of thin lightweight nature. It is so advantageous that a cross sectional area is larger than points, such as incidence effectiveness and transmission efficiency, when using a tooth-back side substrate as a transmission substrate of the incident light from a lighting system, as especially described above, therefore it is so desirable that it is thick. On the other hand, the check-by-looking side substrate is so advantageous that it is thinner than the point of the formation of thin lightweight. Therefore, the thickness of the transparence substrate by the side of a tooth back and a check by looking may be the same, and may be different. In addition, a transparence substrate may be a same thickness plate and thickness may be selectively different like a cross-section wedge for the purpose of improvement in the incidence effectiveness of the transmission light to the optical-path conversion slant face according [especially a tooth-back side substrate] to dip arrangement of an optical-path control layer.

[0020] Moreover, the transparence substrate by the side of a tooth back and a check by looking may have a the same flat-surface dimension, and may be different. When using a tooth-back side substrate as a transmission substrate of the incident light from a lighting system, in the side face of the side which arranges lighting systems 5 and 52 at least, it is more desirable than points, such as incidence effectiveness in the case of having arranged the lighting system on the projection side face, like the example of drawing that it is in the condition that the side face which the tooth-back side substrate 10 forms rather than the side face which the check-by-looking side substrate 20 forms projects.

[0021] Thereby, a transflective reflection layer can realize the thing of lighting and the mold both for outdoor daylight for the purpose of making the back light light at the time of lighting mode penetrate, and reflecting incidence outdoor daylight at the time of outdoor daylight mode. Like the reflecting layer which prepared a half mirror and opening, a transflective reflection layer can penetrate light and can form it as a proper layer to reflect. The metal layer which prepared the metal thin film and opening like a half mirror above all is more desirable than points, such as functional maintenance nature within a liquid crystal cell.

[0022] The balance of the brightness of the back light light at the time of lighting mode and the brightness at the time of outdoor daylight mode etc. can determine suitably the rate of the transmission and the reflection factor of light in a transflective reflection layer. Generally based on permeability, it may be 25 - 75% especially 15 to 85% above all 5 to 95%. By the half mirror method incidentally described above, the rate of the permeability and reflection factor of light is changeable by controlling the pulse duty factor of the opening by the opening method by controlling the thickness.

[0023] In addition, when forming by the opening method which described the transflective reflection layer above, it is more desirable than the point that the thing of the pixel size in a liquid crystal cell which you make opening of 25 - 75% of magnitude correspond to arrangement of a pixel as much as possible, and is made to be distributed raises the homogeneity of the brightness in the display screen especially 15 to 85% above all 5 to 95%. The transflective reflection layer which has opening can be formed by the method with proper punching method, etching method, method vapor-deposited through the mask which prepared predetermined opening.

[0024] As for a transflective reflection layer, it is desirable to be formed so that scatter reflection of the incidence outdoor daylight may be carried out to the point twist of the improvement in utilization effectiveness of outdoor daylight on a concavo-convex front face. When a transflective reflection layer consists of a thick film like a metallic foil, a concavo-convex formula light-scattering side can be formed also by the approach of processing the front face by surface roughening methods, such as buff processing, for example.

[0025] The transflective reflection layer in which is made to carry out scatter reflection of the incidence outdoor daylight with the method which forms the thin film which the irregularity reflected on the other hand by making the front face of for example, a transparence substrate into a concavo-convex formula light-scattering side in the case of the transflective reflection layer which consists of a thin film by a vacuum evaporationo method etc., and it deals can be formed. the point of maintaining the smooth nature of the above-mentioned low refractive-index clear layer in that case -- a front face -- it is desirable to prepare a low refractive-index clear layer using a smooth transparence substrate, and to prepare the layer of surface irregularity structure on it.

[0026] In the case of the above mentioned latter method, since the table rear face of a transflective reflection layer turns into a dispersion

reflector, there is an advantage in which display grace is raised and it deals. That is, when the transmission light inside a substrate reaches a transflective reflection layer in lighting mode, scatter reflection is carried out with the rear face, and a transmission distance becomes short. Moreover, the transmission light which penetrated the transflective reflection layer is also confined in the interior of a check-by-looking side substrate, outgoing radiation prevention is carried out or outgoing radiation prevention of the most is carried out under the effect of absorption, phase contrast generating, etc. by the liquid crystal layer, a light filter layer, etc.

[0027] It can control that transmission light decreases rapidly by absorption by the transflective reflection layer or the actuation circuit the aforementioned result. Moreover, it can control that a display becomes dark by the reduction of transmission light and generating of heterogeneity by the partial change based on the birefringence and light scattering of a liquid crystal layer based on transparency of a transflective reflection layer, and that the ghost phenomenon in which a display in the part near a light source side influences behind occurs. The same is said of the case of the transflective reflection layer of an opening type.

[0028] Although a transflective reflection layer is prepared as what serves as the electrode which forms the circuit for liquid crystal actuation, it is made. Drawing 1 shows the example. Moreover, with a transflective reflection layer, although the transparent electrode which forms the circuit for liquid crystal actuation as a thing of another object is prepared, it can do. Drawing 2 shows the example. The example at the time of using the transparence substrate 10 which has the concavo-convex type light-scattering side described [especially] above by drawing 2 is shown. in this case, the front face [be / that a transparent electrode does not irregularity-ize / desirable / top / transflective reflection layer 11b] aiming at leveling -- smooth transparence insulating-layer 11c is prepared, and 11d of transparent electrodes is formed on it. The transparence insulating layer can be formed by the method with the proper coating layer of for example, transparence resin etc. Moreover, a liquid crystal display can also be formed as what prepared the circuit for liquid crystal actuation between the clear layer of a low refractive index, and the transflective reflection layer.

[0029] The transparence substrate by the side of a check by looking and the transparent electrode prepared in the transparence substrate by the side of a tooth back if needed can be formed with the proper ingredient

according to the former, such as ITO. It can prepare more than two-layer [of proper stratum functionale, such as orientation film which consists of rubbing processing film for carrying out orientation of the liquid crystal if needed on the occasion of formation of a liquid crystal cell etc., and a light filter for color display, / one layer or two-layer]. In addition, like the example of drawing, the orientation film 12 and 22 is usually formed on electrodes 11, 11b, and 21, and a light filter 23 is usually formed between the transparence substrate in one side of the cel substrates 10 and 20, and an electrode. In addition, in the example of drawing, the light filter 23 is formed in the check-by-looking side substrate 20.

[0030] A liquid crystal display panel may add more than two-layer [of proper optical layers, such as polarizing plates 15 and 25, the phase contrast plates 16 and 26, and an optical diffusion layer, / one layer or two-layer] to a liquid crystal cell if needed like the example of drawing 1 and drawing 2 . A phase contrast plate aims [a polarizing plate] at improvement in the display grace by compensation of the phase contrast by the birefringence of liquid crystal etc. for the purpose of the achievement using the linearly polarized light of a display.

Moreover, an optical diffusion layer can arrange one layer or more than two-layer in the proper location between the optical-path control layer 4 and the polarizing plate 25 by the side of a check by looking for the purpose of buildup of the amount of incident light to the optical-path control layer by diffusion of equalization of the brightness by leveling of bright-line-like luminescence through the optical-path conversion slant face of amplification of a display rectangle, or an optical-path control layer by diffusion of display light, and the transmission light in a liquid crystal display panel etc.

[0031] A proper thing can be used as the aforementioned polarizing plate, and there is especially no definition. What has the degree of polarization higher than the point of obtaining the display of the good contrast ratio by the incidence of the advanced linearly polarized light etc. like what prepared transparent protection layer in the absorption mold polarization film which consists of what dichroism matter, such as iodine and dichromatic dye, was made to stick to the hydrophilic high polymer film like for example, a polyvinyl alcohol system film, a partial formal-ized polyvinyl alcohol system film, and an ethylene-vinylacetate copolymer system partial saponification film, and was extended, or its one side or both sides can use preferably.

[0032] What is excellent in transparency, a mechanical strength and thermal stability, moisture electric shielding nature, etc. is

preferably used for formation of said transparent protection layer. As the example, acetate system resin, polyester system resin, polyether sulphone system resin and polycarbonate system resin, Polyamide system resin, polyimide system resin, polyolefine system resin and acrylic resin, The resin of heat-curing molds, such as polyether system resin, a polyvinyl chloride, a polymer like styrene resin or norbornene system resin or acrylic and an urethane system, an acrylic urethane system, and an epoxy system, a silicone system, thru/or an ultraviolet curing mold etc. is raised.

[0033] Although transparent protection layer considered as the film, spreading methods, such as an adhesion method and polymer liquid, etc. can give it. Therefore, the formation technique of this transparent protection layer is also applicable to the above-mentioned formation of a transparence insulating layer.

[0034] The polarizing plate to be used, especially the polarizing plate by the side of a check by looking may perform non-glare processing and acid-resisting processing for the purpose of prevention of the check-by-looking inhibition by the surface echo of outdoor daylight. Non-glare processing can be performed by carrying out detailed irregularity structuring of the front face by various methods, such as a coating method of the resin which blended the combination methods of a transparence particle and transparence particles, such as surface roughening methods, such as a sandblasting method and an embossing method, and a silica, and acid-resisting processing can be performed by the method which forms the vacuum evaporationo film of coherence.

[0035] Moreover, non-glare processing and acid-resisting processing can be performed by the adhesion method of the film which gave aforementioned surface detailed irregularity structure and the aforementioned interference film etc. In addition, like the example of drawing, a polarizing plate can also be prepared in the both sides of a liquid crystal cell, and can also be prepared only in one side of a liquid crystal cell. Moreover, the above mentioned surface detailed irregularity structuring technique can be applied when making the front face of the above-mentioned transflective reflection layer or/and a transparence substrate into a concavo-convex formula light-scattering side.

[0036] What has the proper thing which, on the other hand, supported the oriented films and the orientation layers of those of a proper liquid crystal polymer, such as the birefringence film and nematic system which come to carry out drawing processing of the film which consists of proper polymers, such as what was illustrated by the aforementioned

transparent protection layer even if considered as the phase contrast plate, by the method with proper one shaft, two shafts, etc., and a discotheque system, with the transparence base material can be used. You may be what controlled the refractive index of the thickness direction under the operation of the heating shrinkage force of a heat shrink nature film.

[0037] Usually, like the example of drawing, the phase contrast plates 16 and 26 for compensation are arranged if needed between the polarizing plates 15 and 25 by the side of a check by looking or/and a tooth back, and a liquid crystal cell, and can use a proper thing for the phase contrast plate according to a wavelength region etc. Moreover, more than two-layer can also be superimposed and used for a phase contrast plate for the purpose of control of optical properties, such as phase contrast.

[0038] Moreover, it can prepare by the proper method by a coating layer, a diffusion sheet, etc. which have the surface detailed irregularity structure which applied to the aforementioned non-glare layer correspondingly also about the optical diffusion layer. An optical diffusion layer can also be formed as a layer which serves as adhesion of a polarizing plate and a phase contrast plate as an adhesive layer of transparence particle combination, and, thereby, can also attain thin shape-ization. The binder which makes a base polymer proper polymers, such as a rubber system, acrylic, a vinyl alkyl ether system and a silicone system, a polyester system and a polyurethane system, a polyether system, and a polyamide system, a styrene system, can be used for formation of the adhesive layer.

[0039] What is excellent in transparency, weatherability, thermal resistance, etc. is preferably used like the acrylic binder which makes a base polymer the polymer which makes a subject the alkyl ester of an acrylic acid thru/or a methacrylic acid above all. moreover, proper things, such as an organic system particle which the conductive thing which consists of the silica whose mean diameter is 0.5-20 micrometers, for example, an alumina, a titania and a zirconia, tin oxide and indium oxide, cadmium oxide, antimony oxide, etc. as the aforementioned transparence particle which has blended with the adhesive layer also becomes from the polymer for which a bridge is not constructed [a certain inorganic system particle, bridge formation, or], -- one sort -- or two sorts can be used. This transparence particle can be used for the above-mentioned non-glare processing etc.

[0040] The lighting system arranged on the side face of a liquid crystal display panel aims at carrying out incidence of the light used as illumination light of a liquid crystal display from the side face of a

liquid crystal display panel. Thin lightweight-ization of a liquid crystal display can be attained in combination with the optical-path control layer which this arranges to a back-in-panels side. It is the method arranged to the side face of the tooth-back side substrate made to project rather than the side face which the side face of a tooth-back side substrate, especially a check-by-looking side substrate form from the point of preventing the incidence to the liquid crystal layer of the incident light from a lighting system like the example of drawing which described above the desirable arrangement method of a lighting system.

[0041] the array object which could use the thing proper as a lighting system, for example, (cold, heat) arranged the point light source and it of a linear light source, light emitting diode, etc. of a cathode-ray tube etc. a line, in the shape of a field, etc. or the point light source, and a line -- a light guide plate -- combining -- the incident light from the point light source -- a line -- the lighting system changed into the linear light source through the light guide plate can use preferably.

[0042] Lighting systems 5 and 52 can be arranged like drawing 1 and the example of 2 on 1 or two or more side faces in a liquid crystal display panel. When arranging a lighting system on two or more side faces, two or more of the side faces may be the combination of the side face which counters like the example of drawing 2 , may be the combination of the side face which crosses in all directions, and may be the combination of three or more side faces which used them together.

[0043] A lighting system enables a check by looking with the lighting mode by the burning. Since there is no need for burning when checking by looking in the outdoor daylight mode by outdoor daylight in lighting and the mold both for outdoor daylight, its burning and putting out lights shall be changed. Arbitrary methods can be taken to the change method, and all of the conventional method can be taken. In addition, a lighting system may be the thing of the unique luminescence type which can change the luminescent color, and unique luminescence of it shall be carried out through a lighting system of a different kind, and it shall deal in it.

[0044] In order to lead divergence light to the side face of a liquid crystal display panel to lighting systems 5 and 52 if needed like the example of drawing, it can also consider as the combination object which has arranged proper auxiliary means, such as the light source holder 51 which surrounds it. As a light source holder, a lighting-system side can use at least the proper reflective sheet which reflects light like the resin sheet which attached the metal thin film of a high reflection

factor, for example, a white sheet, a metallic foil, resin mold goods, etc. A light source holder can also be used as a maintenance means which serves as envelopment of a lighting system by the method which pastes up the edge on the edge of the vertical side of the cel substrate of a liquid crystal display panel, especially a tooth-back side substrate.

[0045] An optical-path control layer is arranged on the outside of the tooth-back side substrate 10 of the liquid crystal display panel 1 for the purpose of carrying out optical-path conversion and using for the check-by-looking side of the panel concerned the incident light thru/or its transmission light from the lighting system 5 arranged on the side face of the liquid crystal display panel 1 as the arrow head alpha showed to drawing 1 as illumination light (display light) through the optical-path conversion slant face A1.

[0046] From the aforementioned object, the optical-path control layer 4 shall have the optical-path conversion slant face A1 whose tilt angle to the base plane (virtual level surface) of a tooth-back side substrate is 35 - 48 degrees, in order to reflect the incident light from lighting systems 5 and 52 and to carry out optical-path conversion in the predetermined direction like drawing 1 and the example of 2. Moreover, an optical-path control layer shall have the plurality of said optical-path conversion slant face for the purpose of thin-shape-izing. Furthermore, an optical-path control layer is formed as a layer with a refractive index higher than the clear layer of the low refractive index prepared in the tooth-back side substrate. If the refractive index of an optical-path control layer is lower than that of the clear layer concerned, the incident light thru/or its transmission light from a lighting system will be easy to be shut up in a tooth-back side substrate, the incidence to an optical-path control layer will be checked, and it will be hard coming to use as a display light.

[0047] An optical-path control layer can be formed as a thing of a proper gestalt except for the point of having the plurality of the above mentioned predetermined optical-path conversion slant face. The optical-path control layer which has the plurality possessing the optical-path conversion slant face A1 which meets, the side face, i.e., the incidence side face, which has arranged the lighting system, of the light-emission gunner stage A, especially the optical-path control layer which has the plurality possessing the optical-path conversion slant face A1 which consists of prism-like unevenness of the light-emission gunner stage A are more desirable than the point of obtaining the display light which is excellent in the directivity to the direction of a transverse plane through optical-path conversion etc.

[0048] The example of the light emission gunner stage which has the above mentioned optical-path conversion slant-face thru/or prism-like unevenness was shown in drawing 3 (a) - (e). The (a) The light emission gunner stage A consists of a thing of a cross-section triangle in - (c), and it consists of a thing of a cross-section square in (d) and (e). Moreover, at (a), it has the optical-path conversion slant face A1 of the 2nd page by the isosceles triangle, and has the light emission gunner stage A which has the steep incline A2 with the larger tilt angle to the optical-path conversion slant face A1 and a base plane than a slant face A1 by (b).

[0049] At (c), the light emission gunner stage A which makes a unit the optical-path conversion slant face A1 and the gentle slope A2 where the tilt angle to a base plane is small consists of what was formed all over optical-path control-layer one side by the contiguity successive state, and it has the light emission gunner stage A which consists of a crevice (slot) the light emission gunner stage A which consists of heights (projection) by (e) by (d).

[0050] therefore, the heights or the crevice where a light emission gunner stage consists of an equilateral side thru/or a slant face of the same tilt angle like said example carried out -- even if -- the heights or the crevice which consists of a slant face from which it can form and an optical-path conversion slant face, a steep incline or a gentle slope thru/or a tilt angle are different -- even if -- it can form and the slant-face gestalt can be suitably determined according to the number and location of an incidence side face. Being formed as a light emission gunner stage which consists of a crevice rather than heights is hard to get damaged and has a slant face more advantageous than the point of maintenance of the slant-face function by improvement in abrasion-proof nature etc.

[0051] Like the example of drawing, an optical-path control layer more desirable than the point of attaining properties to the above-mentioned direction of a transverse plane, such as directivity, etc. meets an incidence side face, and has the optical-path conversion slant face A1 whose tilt angle to a base plane is 35 - 48 degrees. Therefore, when a lighting system is arranged on two or more side faces of a liquid crystal display panel and it has two or more incidence side faces, what was made into the optical-path control layer which has the optical-path conversion slant face A1 corresponding to the number and location is used preferably.

[0052] In arranging lighting systems 5 and 52 on two side faces in which the liquid crystal display panel 1 incidentally counters like the

example of drawing 2 The optical-path conversion slant face A1 of the 2nd page by the light emission gunner stage A which consists of a cross-section isosceles triangle like drawing 3 (a), The optical-path control layer 4 which has the optical-path conversion slant face A1 of the 2nd page by the light emission gunner stage A which consists of a cross-section trapezoid like drawing 3 (d) and (e) in the condition that the ridgeline serves as a direction along an incidence side face is used preferably.

[0053] Moreover, when arranging a lighting system on two side faces which adjoin by every direction of a liquid crystal display panel, the optical-path control layer which has the optical-path conversion slant face A1 in the condition of meeting the both directions where a ridgeline is in every direction corresponding to the side face is used preferably. When arranging a lighting system on three or more side faces which furthermore contain opposite and every direction, the optical-path control layer which has the optical-path conversion slant face A1 which consists of the aforementioned combination is used preferably.

[0054] The above mentioned optical-path conversion slant face A1 carries out the role which carries out optical-path conversion and which reflects in the field A1 the light which carries out incidence among the incident light from the incidence side face through a lighting system thru/or its transmission light, and is supplied to the check-by-looking side of a liquid crystal display panel. In that case, by making the tilt angle to the base plane of the optical-path conversion slant face A1 into 35 - 48 degrees, as illustrated by the broken line arrow head alpha to drawing 1 , the display light which improves [perpendicularity] side-face incident light thru/or its transmission light optical-path conversion to a base plane, and is excellent in the directivity to a transverse plane can be obtained efficiently.

[0055] If the optical path of the reflected light is larger than the direction of a transverse plane, and the tilt angle of an optical-path conversion slant face shifts, becomes deficient in the brightness of the direction of a transverse plane that it is hard to use effectively for a display and exceeds 48 degrees at less than 35 degrees, it will separate from the conditions to which total reflection of side-face incident light thru/or its transmission light is carried out, the leakage light from an optical-path conversion slant face will increase, and it will become scarce at the efficiency for light utilization of side-face incident light.

[0056] In consideration of the total reflection conditions based on refraction by the Snell's law of light with which the desirable tilt

angle of the optical-path conversion slant face A1 is transmitted in the inside of a liquid crystal display panel from the points of excelling in the directivity to a transverse plane, such as optical-path conversion and control of leakage light, etc., it is 40 - 44 degrees above all 38 to 45 degrees. Incidence will be carried out to an optical-path conversion slant face, side-face incident light being transmitted [the general total reflection conditions of a glass plate are about 42 degrees, therefore] in that case, incidentally, after having been together put by the range of **42 degrees.

[0057] As mentioned above, drawing 4 is prepared for the purpose of thin-shape-izing of an optical-path control layer, and, as for the light emission gunner stage A possessing the optical-path conversion slant face A1, plurality is prepared in 5 like instantiation. In that case, it is more desirable than the point of reflecting the incident light from an incidence side face back, transmitting to a pair opposite side side side efficiently, and making homogeneity emitting light as much as possible all over a liquid crystal display that the tilt angle to a base plane takes above all for the structure containing flat side A3 whose gentle slope A2 thru/or tilt angle concerned of 3 or less times is zero abbreviation especially 5 or less times 10 or less degrees. Therefore, in especially the light emission gunner stage A that contains the steep incline A2 of instantiation in drawing 3 (b), it is desirable to make width of face of flat side A3 into the structure which can make the include angle of the steep incline large as 60 degrees or more above all 50 degrees or more 35 degrees or more.

[0058] Although it is prepared so that the incidence side face of the liquid crystal display panel 1 to which, as for the light emission gunner stage A, the ridgeline has arranged the lighting system 5 like instantiation to drawing 4 and 5 may be met in the state of parallel or dip, the light emission gunner stage A carries out rear-spring-supporter continuation from the end of an optical-path control layer like drawing 4 in that case at the other end, and you may be formed, and it may be formed intermittently and discontinuously like drawing 5 . When forming discontinuously, it is desirable to make into 5 or more times of the depth or height lay length along the incidence side face of the irregularity which consists of the slot or projection from points, such as incidence effectiveness, optical-path conversion efficiency, etc. of transmission light, and it is more desirable than the point of the formation of homogeneity luminescence of the panel screen to set especially 500 micrometers or less of 10-480 micrometers of said die length to 50-450 micrometers above all. In addition, the transflective

reflection layer is omitted in drawing 4 and 5.
[0059] There is especially no definition about the pitch of the optical-path conversion slant face A1 through the cross-section configuration of the light emission gunner stage A, or it. From the optical-path conversion slant face A1 serving as a brightness determinant in lighting mode, according to the homogeneity of luminescence in the panel screen etc., it can determine suitably, and the optical-path conversion quantity of light can be controlled by the distribution density. therefore, the slant face A -- you may be a configuration with the tilt angle of 1 and 2 fixed all over an optical-path control layer etc., and ****** may enlarge the light emission gunner stage A from an incidence side face like instantiation at drawing 6 for the purpose of coping with attenuation of the transmission light by the absorption loss or previous optical-path conversion, and attaining equalization of luminescence of the panel screen.
[0060] Moreover, it should also consider as the light emission gunner stage A of constant pitch like instantiation at drawing 6 , ****** should narrow the pitch more nearly gradually from the incidence side face like instantiation at drawing 7 , and distribution density of the light emission gunner stage A should be made [many]. Furthermore, equalization of luminescence in the panel screen can also be attained in a random pitch.
[0061] in addition -- making irregular the magnitude of the irregularity, a configuration and distribution density, the direction of a ridgeline, etc. in the case of the irregularity which the light emission gunner stage A becomes from a discontinuous slot or a discontinuous projection **** -- the irregular **** -- regular equalization of luminescence [in / it is, and it carries out, and uniform irregularity is arranged at random, and / the panel screen] can also be attained. Therefore, equalization of luminescence by the panel screen can be attained with the application of a proper method in the light emission gunner stage A like the above mentioned example. In addition, in drawing 6 and 7, the direction of an arrow head is the transmission direction of the incident light from an incidence side face.
[0062] Since it is the functional division of substantial illumination-light formation, an optical-path conversion slant face has the case depended on optical-path conversion of side-face incident light as mentioned above where the lighting at the time of burning serves as a non-dense, and serves as an unnatural display, when the spacing is too large. As for especially the pitch of the optical-path conversion slant face A1, it is more desirable than the point of the prevention that 50

micrometers - 0.5mm costs 20 micrometers - 1mm above all 2mm or less.
[0063] The illumination light which, on the other hand, minded two or more optical-path conversion slant faces, especially the optical-path conversion slant face which continued in the direction of an incidence side face may interfere with the pixel of a liquid crystal cell, and may produce moire. Although prevention of moire can be performed by pitch accommodation of an optical-path conversion slant face, there is range desirable as mentioned above in the pitch. Therefore, a solution in case moire arises in the aforementioned desirable pitch range poses a problem.
[0064] In the aforementioned case, the method which forms a concavo-convex ridgeline in the condition of inclining to an incidence side face, and prevents moire so that an optical-path conversion slant face can arrange in the state of a crossover to a pixel is desirable. In that case, if the tilt angle to an incidence side face is too large, since a deflection will be produced in the echo through an optical-path conversion slant face, a big bias will occur towards optical-path conversion and it will be easy to become the cause of lowering of display grace, as for the tilt angle to the incidence side face of the ridgeline, it is desirable to consider as less than **25 degrees above all less than **30 degrees. In addition, the sign of ** means the dip direction of the ridgeline on the basis of an incidence side face. The resolution of a liquid crystal cell is low, and when the case where moire is not produced, and moire can be disregarded, this ridgeline is so desirable that it is parallel to an incidence side face.
[0065] It also takes into consideration that the pixel pitch of a liquid crystal cell is generally 100-300 micrometers from the aforementioned point, and, as for an optical-path conversion slant face, it is desirable to form based on the projection width of face to the base plane, so that 3-20-micrometer 40 micrometers or less may turn into 5-15 micrometers especially above all. Generally this projection width of face has the coherent length of fluorescence tubing more desirable than the point of preventing deterioration of the display grace by diffraction from the point set to about 20 micrometers.
[0066] According to the wavelength region of a lighting system, transparency is shown in it and an optical-path control layer can be formed with an ingredient with a high refractive index more proper than the clear layer of the above-mentioned low refractive index.
Incidentally the polymer thru/or hardening mold resin illustrated by the above-mentioned transparent protection layer etc., glass, etc. are raised in a light region. The optical-path control layer which did not show a birefringence or was formed with the small ingredient of a

birefringence is desirable.
[0067] moreover, the loss quantity of light which is confined in the interior of a panel and cannot carry out outgoing radiation in an interface echo -- controlling -- side-face incident light thru/or its transmission light -- an optical-path control layer and the point especially supplied to the optical-path conversion slant face efficiently -- the clear layer of the above-mentioned low refractive index -- a refractive index -- 0.05 or more -- above all -- 0.08 or more -- especially -- 0.1-0.4 -- it is desirable that it is a high optical-path control layer. It is more desirable than the point of carrying out incidence of the incident light thru/or its transmission light from a lighting system to an optical-path control layer efficiently from a tooth-back side substrate furthermore, and attaining a bright display through an optical-path conversion slant face that refractive-index differences with a tooth-back side substrate are less than 0.05 optical-path control layers especially less than 0.10 above all less than 0.15 and that it is the optical-path control layer of a refractive index especially higher than the transparence substrate concerned.
[0068] An optical-path control layer can be formed also by the cutting method, and can be formed by the proper approach. As the manufacture approach more desirable than points, such as mass production nature For example, the approach of imprinting a ****** configuration under heating to the metal mold which can form a predetermined configuration for thermoplastics, The approach of filling up the metal mold which can fabricate the resin made to fluidize through thermoplastics, or the heat and solvent which carried out heating melting in a predetermined configuration, The approach of filling up thru/or casting and carrying out polymerization of the monomer and oligomer which can carry out polymerization, or the liquefied resin to the mold which can form a predetermined configuration with heat, ultraviolet rays thru/or a radiation, etc., is raised.
[0069] Moreover, the approach of carrying out coating of the aforementioned liquefied resin which can carry out polymerization to a support film with ultraviolet rays thru/or a radiation, etc. beforehand, and fabricating the coating layer in the mold which can form a predetermined configuration, and carrying out polymerization etc. is raised. In that case, the optical-path control layer united with the film using the transparent support film can also be formed, and the optical-path control layer which exfoliates with a support film and consists only of a shaping layer based on the coating layer concerned after formation can also be formed. In that case, it is not necessary to

be a bright film. Exfoliation can be attained by the approach of carrying out surface treatment of the support film by the remover etc.
[0070] Therefore, an optical-path control layer can also give and form the predetermined gestalt in a tooth-back side substrate etc. directly, and can also form it as a transparence sheet which gave the predetermined gestalt. Although the thickness of an optical-path control layer can be determined suitably, especially generally it is set to 10-100 micrometers 5-200 micrometers above all 300 micrometers or less from points, such as thin-shape-izing. In addition, configurations, such as 3 based on the cross section of a light emission gunner stage - a pentagon, do not mean a strict polygon, and a radius of circle of a corner, distortion of a field, etc. based on a manufacturing technology etc. are permitted.
[0071] As for an optical-path control layer, it is more desirable than the point of the improvement in brightness by deployment of the reflective effectiveness through the optical-path conversion slant face A1 of the light emission gunner stage A, as a result side-face incident light etc. to arrange in that case by carrying out drawing 1 and the field which formed the slant-face forming face A, i.e., a light emission gunner stage, in 2 like instantiation outside (tooth-back side), although arranged at the tooth-back side of a liquid crystal display panel.
[0072] the glue line 18 of a refractive index higher than the clear layer 14 of the low refractive index which described the transparence sheet etc. above like the example of drawing when an optical-path control layer is independently formed as a transparence sheet etc. like the above -- above all -- the transparence sheet etc. -- as much as possible -- etc. -- it carries out, and it is and is more desirable than the glue line of a refractive index, the point of the above [pasting a liquid crystal display panel through the glue line of the middle refractive index of the transparence sheet etc. and a tooth-back side substrate especially], etc.
[0073] Therefore, the refractive index of said glue line may apply to the above-mentioned optical-path control layer correspondingly. Therefore, as for the refractive index of an optical-path control layer and a glue line, it is desirable that it is [0.05 or more] higher than the clear layer of a low refractive index. A glue line can be formed with proper transparence adhesives, and there is especially no definition about the class of the adhesives. The adhesion method by the adhesive layer is more desirable than points, such as the simple nature of an adhesion processing activity. About the adhesive layer, it can

apply correspondingly above and can also consider as the adhesive layer of the above-mentioned optical diffusion mold.

[0074] Like the example of drawing, the light reflex layer 6 can also be arranged if needed to the tooth-back side (outside) of the optical-path control layer 4. The reflected light through an optical-path control layer carries out reflective reversal of reflective reversal being carried out and stopping being able to carry out ****** outgoing radiation in the transflective reflection layer inside a liquid crystal cell in the light reflex layer again, and this light reflex layer aims at returning in the direction of a liquid crystal cell, and raising the utilization effectiveness of light, as a result brightness. Moreover, reflective reversal of the outdoor daylight which penetrated the transflective reflection layer also in outdoor daylight mode is carried out, and it returns in the direction of a liquid crystal cell, and is effective in improvement in the utilization effectiveness of light, as a result brightness. It is effective also in improvement in the efficiency for light utilization by carrying out reflective reversal and furthermore, carrying out re-incidence of the leakage light from an optical-path control layer.

[0075] A light reflex layer can be formed in proper things, such as a white sheet according to the former. Above all For example, the coating layer which made the metal of high reflection factors, such as aluminum, silver and gold, copper, and chromium, thru/or the powder of the alloy contain in binder resin, The metal thin film layer which comes to attach an aforementioned metal etc. and an aforementioned dielectric multilayer by the thin film formation method with proper vacuum deposition method, sputtering method, etc., The light reflex layer of the high reflection factor which consists of a reflective sheet which supported an aforementioned coating layer and an aforementioned attachment layer with the base material which consists of a film etc., a metallic foil, etc., and the light reflex layer which has a metal thin film at least especially are more desirable than points, such as reflective effectiveness. In addition, the formation technique of this light reflex layer is applicable to formation of the above-mentioned transflective reflection layer.

[0076] The adhesion attachment of the light reflex layer may be carried out at the rear face of an optical-path control layer like the example of drawing 1 . The method which carries out vacuum deposition of the metal thin film as opposed to an optical-path control layer, the method which pastes up the flexible reflective sheet which vapor-deposited the metal thin film through a glue line can perform formation of this light

reflex layer 6. In the case of the latter, a small thing can transmit transmission light efficiently by the total reflection based on the refractive-index difference of an interface, and the refractive index of a glue line has it. [more desirable than an optical-path control layer]

[0077] Moreover, a light reflex layer can also be prepared like the example of drawing 2 in the condition and the condition of having separated from the rear face further which leave with the light emission gunner stage of an optical-path control layer, and are stuck to the rear face of an optical-path control layer. White films, such as a foaming plastic film, etc. are preferably used for the reflective sheet and pan which prepared the metal sheet of a high reflection factor, and the metal thin film of a high reflection factor in the light reflex layer. Incidentally, in the example of drawing 2 , it consisted of a metal thin film which light reflex layer 6b attached to transparent support base material 6a, and it has pasted up through glue line 6c of a low refractive index rather than the optical-path control layer 4 for the purpose of improvement in efficiency for light utilization.

[0078] Although a light reflex layer may be a mirror plane, what shows an optical diffusion function is more desirable than the viewpoint of moire prevention. Like the above, a light reflex layer may be in the condition of having only put on the outside of an optical-path control layer, and having put on it, and may be in the condition that adhesion arrangement was carried out by the adhesion method, the vacuum evaporationo method, etc. When adhesion arrangement of the light reflex layer is carried out like the example of drawing 1 on the slant face of a light emission gunner stage, leakage light can be prevented nearly thoroughly by improvement in a reflection effect, and there is an advantage which a viewing-angle property and brightness are raised more and deals in them.

[0079] The method which prepares the light reflex layer which made the detailed irregularity structure reflect in the film base material which made the front face detailed irregularity structure by the surface roughening method of the front face by sandblasting, mat processing, etc. and the method with a proper particle addition method etc. can perform formation of the reflecting layer of the above mentioned optical diffusion mold. Formation of the light reflex layer of the detailed irregularity structure in which the detailed irregularity structure of the front face was made to reflect can be performed by the approach of attaching a metal to front faces, such as a film base material, by methods with proper vacuum evaporationo method, plating method, etc.,

such as for example, a vacuum deposition method, and an ion plating method, a sputtering method, etc. The formation technique of this optical diffusion type of reflecting layer is applicable to formation of the above-mentioned transflective reflection layer.

[0080] According to the liquid crystal display by this invention, it sets in lighting mode. Most incident light from an incidence side face A liquid crystal display panel, Being back transmitted through the echo by law of refraction through the tooth-back side substrate, and the outgoing radiation (leaking) on the front face of a panel being prevented especially It is efficient and optical-path conversion is improved light which carried out incidence to the optical-path conversion slant face A1 of an optical-path control layer by vertical directivity to the check-by-looking direction, other transmission light is back transmitted further in total reflection, and carries out incidence to the optical-path conversion slant face A1 in back, it is efficient and optical-path conversion is improved them by vertical directivity to the check-by-looking direction.

[0081] Next, the light which reached the transflective reflection layer and penetrated it carries out incidence to a liquid crystal cell, display light is formed, and the light by which optical-path conversion was carried out on the aforementioned optical-path conversion slant face can attain the display which is excellent in the homogeneity of brightness on the whole surface of the panel screen. On the other hand, in outdoor daylight mode, it can attain the display which is excellent in the homogeneity of brightness on the whole surface of the panel screen, light which the outdoor daylight which carried out incidence from the check-by-looking side reached the transflective reflection layer, then was reflected being used as display light by the liquid crystal cell.

[0082] When a light reflex layer is prepared in the outside of an optical-path control layer, like the above, efficiency for light utilization improves and brightness improves more. Therefore, the liquid crystal display of the lighting and the mold both for outdoor daylight which is excellent in display grace it is bright and legible, using the light from a lighting system efficiently can be formed.

[0083] in addition, laminating unification is carried out on the whole or selectively, and the optical element thru/or components which form the liquid crystal display described above in this invention, such as an optical-path control layer, a liquid crystal cell and a polarizing plate, and a phase contrast plate, fix -- having -- **** -- separation -- it may be arranged at the easy condition. It is more desirable than points,

such as lowering prevention of the contrast by control of an interface echo, that it is in a fixing condition. Proper transparence adhesives, such as a binder, can be used for the fixing adhesion processing, and it can also consider as the glue line which is made to contain the transparence particle described above to the transparence glue line, and shows a diffusion function.

[0084] Moreover, ultraviolet absorption ability can also be given to it by the side of the aforementioned optical element thru/or components, especially a check by looking with the method processed with ultraviolet ray absorbents, such as for example, a salicylate system compound, a benzophenone system compound, a benzotriazol system compound, and a cyanoacrylate system compound, a nickel complex salt system compound.

[0085]

[Example] Vacuum deposition of the magnesium fluoride was carried out to the alkali-free-glass plate of 0.7mm in example of reference 1 thickness, and a refractive index 1.52, the low refractive-index clear layer of 600nm in thickness and a refractive index 1.38 was formed, and the resin layer of surface detailed irregularity structure was prepared on it. Next, the transflective reflection layer which forms so that vacuum deposition of the aluminum may be carried out and opening of 250-micrometer angle may be uniformly distributed with 20% of numerical aperture by the etching method on it, and serves as an electrode was prepared, the spin coat of the polyvinyl alcohol solution was carried out on it, rubbing processing of the desiccation film was carried out, and the tooth-back side substrate was obtained. On the other hand, the ITO transparence conductive layer was formed in the same alkali-free-glass plate as the above, after etching and dividing the transparent electrode, the rubbing processing film was prepared on it and the check-by-looking side substrate was obtained.

[0086] Subsequently, the aforementioned tooth-back side substrate and the check-by-looking side substrate were made to counter so that the direction of rubbing may intersect the rubbing side perpendicularly, gap accommodation material was allotted, after carrying out the seal of the perimeter with an epoxy resin, liquid crystal (the Merck Co. make, ZLI-4792) was poured in, TN system liquid crystal cell was formed, the polarizing plate with a phase contrast plate was stuck on the both sides, and Nor Marie White's liquid crystal panel was obtained. The panel size is 34mm in width of face of 25mm, and die length, and one side face of the tooth-back side substrate of the die-length direction projects 2mm rather than a tooth-back side substrate. Next, the cold cathode tube has been arranged on the projection side face of the tooth-back side

substrate, it surrounded with the polyester film of silver vacuum evaporationo, the film edge was pasted up on the vertical side of a substrate with the pressure sensitive adhesive doudle coated tape, and maintenance immobilization of the cold cathode tube was carried out.
[0087] The liquid crystal panel of Nor Marie White who the low refractive-index clear layer which becomes an example of reference 2 tooth-back side substrate from magnesium fluoride is not prepared, and also made the cold cathode tube hold to a both-sides side according to the example 1 of reference was obtained.
[0088] the example 3 of reference -- the ultraviolet curing mold resin (the Toagosei make --) of acrylic [metal mold / into which the predetermined configuration was processed beforehand] After carrying out dropping restoration of ARONIKKUSU UV-3701 by the syringe, put a polycarbonate (PC) film with a thickness of 60 micrometers on it, making it stick by the rubber roller, removing excessive resin and excessive air bubbles, irradiating ultraviolet rays with a metal halide lamp and carrying out hardening processing, It exfoliated from metal mold, and it judged in the predetermined dimension, PC film was exfoliated, the optical-path control layer (transparence sheet) of a refractive index 1.51 was obtained, and the acrylic adhesive layer of a refractive index 1.51 was attached to the field which does not have the optical-path control layer.
[0089] In addition, it has continuously the prism-like crevice where the aforementioned transparence sheet is 28mm in width of face of 22mm, and die length, and a ridgeline inclines at the include angle of 21 rear spring supporters crosswise in the pitch of 190 micrometers. At 42 degrees, the tilt angle of the optical-path conversion slant face is 70 degrees (drawing 3 b), and a vertical angle with a steep incline A2 consists [the projection width of face to the base plane of an optical-path conversion slant face] of a thing [as opposed to an optical-path conversion slant face and the base plane of a steep incline in the area of a flat part (A3)] of 10 times or more of projection sum total area by 7-12 micrometers.
[0090] According to the example 3 of reference, the transparence sheet with an adhesive layer was obtained using metal mold different example of reference 4. This transparence sheet has the light emission gunner stage (drawing 3 b) with a die length of 80 micrometers where a tilt angle consists of an optical-path conversion slant face A1 whose projection width of face to a base plane is 10 micrometers, and a steep incline A2 whose tilt angle is about 75 degrees at about 42 degrees in the condition with that die-length direction parallel to an incidence

side face. And ****** arranges the light emission gunner stage to high density more nearly gradually than the incidence side face of the die-length direction (drawing 5 , drawing 7), and the area of a flat part (A3) is 10 or more times of projection sum total area to an optical-path conversion slant face and the base plane of a steep incline.

[0091] The metal mold which carried out surface roughening processing of the front face was used with example of reference 5 sandblasting, and also the transparence sheet with an adhesive layer was obtained according to the example 3 of reference.

[0092] According to the example 3 of reference, the transparence sheet with an adhesive layer was obtained using metal mold different example of reference 6. This transparence sheet has a prism-like crevice continuously in the pitch of 190 micrometers (drawing 3 b), projection width of face [as opposed to / in a vertical angle with a steep incline A2 / tilt angle / of that optical-path conversion slant face A1 / the base plane of 70 degrees and an optical-path conversion slant face at 30 degrees] is 7-12 micrometers, and the area of a flat part (A3) consists of a thing of 10 times or more of projection sum total area to an optical-path conversion slant face and the base plane of a steep incline.

[0093] The transparence sheet which carried out vacuum deposition of the aluminum to the light emission gunner stage forming face of the optical-path control layer formed according to the example 3 of example of reference 7 reference, and prepared the light reflex layer was obtained.

[0094] the example 8 of reference -- vacuum deposition of the aluminum was carried out to the front face of a transparent plastic film, and the light reflex sheet was obtained.

[0095] the example 9 of reference -- vacuum deposition of the aluminum was carried out to the front face of a transparent plastic film, the adhesive layer of a refractive index 1.41 was formed on it, and the light reflex sheet was obtained.

[0096] The transparence sheet of the example 3 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 1 of example 1 reference through the adhesive layer, only the circumference pasted up the light reflex sheet of the example 8 of reference on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.

[0097] The transparence sheet of the example 3 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 1 of example 2 reference through the adhesive layer, the light reflex sheet of the example 9 of reference was pasted up on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.

[0098] The transparence sheet of the example 4 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 1 of example 3 reference through the adhesive layer, only the circumference pasted up the light reflex sheet of the example 8 of reference on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.
[0099] The transparence sheet of the example 7 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 1 of example 4 reference through the adhesive layer, and the liquid crystal display was obtained.
[0100] The transparence sheet of the example 3 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 2 of example of comparison 1 reference through the adhesive layer, only the circumference pasted up the light reflex sheet of the example 8 of reference on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.
[0101] The transparence sheet of the example 3 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 2 of example of comparison 2 reference through the adhesive layer, the light reflex sheet of the example 9 of reference was pasted up on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.
[0102] The transparence sheet of the example 5 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 1 of example of comparison 3 reference through the adhesive layer, only the circumference pasted up the light reflex sheet of the example 8 of reference on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.
[0103] The transparence sheet of the example 6 of reference was pasted up on the tooth-back side of the liquid crystal panel of the example 1 of example of comparison 4 reference through the adhesive layer, only the circumference pasted up the light reflex sheet of the example 8 of reference on the tooth-back side through the adhesive layer, and the liquid crystal display was obtained.
[0104] About the liquid crystal display obtained in the assessment trial example and the example of a comparison, the cold cathode tube was made to turn on in the condition of not impressing an electrical potential difference to a liquid crystal cell in a dark room, and the transverse-plane brightness in a mid gear was investigated with the luminance meter (the TOPCON CORP. make, BM7). Moreover, the display grace at the time of observing the display by lighting mode at an incidence side-face edge, a

center section, and an opposite edge was evaluated. Assessment made x ** and the case where it was dark and uneven, when a little inferior to 0, brightness, or its homogeneity in the case where it is bright, excel in the homogeneity, and light is carrying out outgoing radiation good.

[0105] The aforementioned result was shown in degree table.

Transverse-plane brightness Table ** Elegance Grade (cd/m2) Incidence side-face edge Center section Opposite edge An example 1 58 0 0 0 An example 2 42 0 0 0 An example 3 51 0 0 0 An example 4 44 0 0 ** The example 1 of a comparison 29 0 ** ** Example 2 of a comparison 25 0 ** x Example 3 of a comparison 21 **** x Example of comparison 419 ** ** x

[0106] Although the bright and uniform display is attained in lighting mode from the table in the example, in the example of a comparison, it is dramatically dark or it turns out that it is an uneven display. Moreover, in the examples 1 and 2 which have a low refractive-index clear layer, although brightness and its homogeneity were high, in the examples 1 and 2 of a comparison which do not have a low refractive-index clear layer, ****** became dark more rapidly, and it turned out that the heterogeneity of the brightness considered to be the effect of a transflective reflection layer is large, and did not see dramatically from an incidence side face, but was a **** display.

[0107] Moreover, neither in the example 3 of a comparison which made the optical-path control layer the split face, nor the example 4 of a comparison with the small slant-face include angle of an optical-path control layer, optical outgoing radiation was made effectively, but it was dark. In any [of an example and the example of a comparison] case, the good way of being visible is adopted in outdoor daylight mode, and the effect of a low refractive-index clear layer was not accepted at all. As mentioned above, it turns out that the liquid crystal display of the thin and lightweight the lighting and the mold both for outdoor daylight which can emit light only by forming light equipment in a liquid crystal panel end face is realized, without using a light guide plate by this invention.

[Translation done.]

2.**** shows the word which can not be translated.
3.In the drawings, any words are not translated.

DESCRIPTION OF DRAWINGS

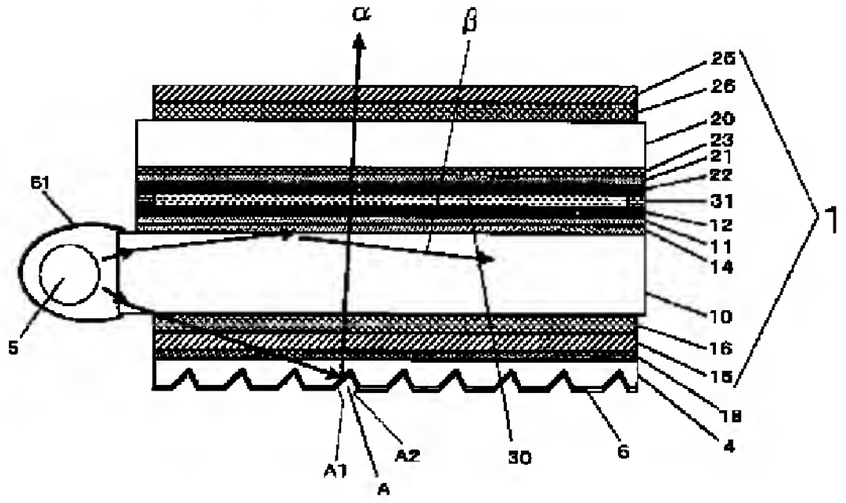
[Brief Description of the Drawings]
[Drawing 1] The explanation sectional view of an example
[Drawing 2] The explanation sectional view of other examples
[Drawing 3] The side-face explanatory view of the light emission gunner stage in an optical-path control layer
[Drawing 4] The strabism explanatory view of the example of further others
[Drawing 5] The strabism explanatory view of the example of further others
[Drawing 6] The side-face explanatory view of the example of an optical-path control layer
[Drawing 7] The side-face explanatory view of other examples of an optical-path control layer
[Description of Notations]
1: Liquid crystal display panel
10 20: Transparence substrate
11 11b: Transflective reflection layer
21: Transparent electrode
12 22: Orientation film
14: The clear layer of a low refractive index
15 25: Polarizing plate
16 26: Phase contrast plate
23: Light filter
30: Liquid crystal
4: Optical-path control layer
A: Light emission gunner stage
A1: Optical-path conversion slant face
5 52: Lighting system
6: Light reflex layer

[Translation done.]

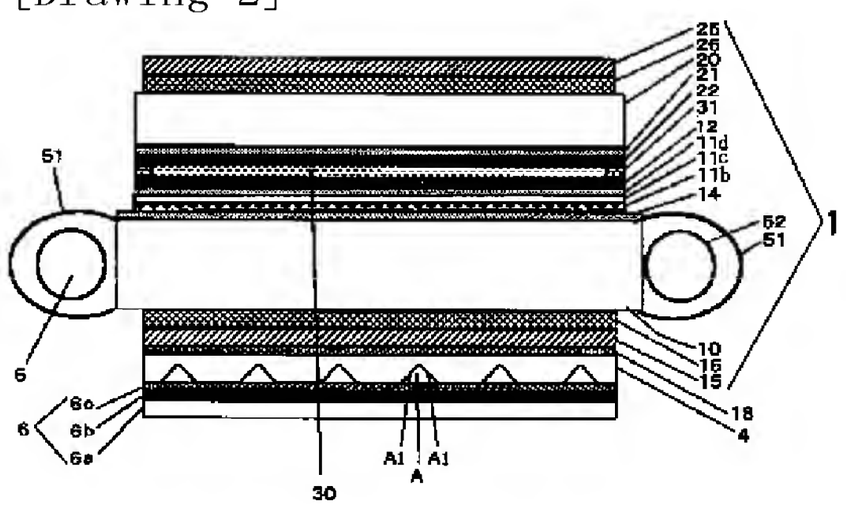
* NOTICES *

DRAWINGS

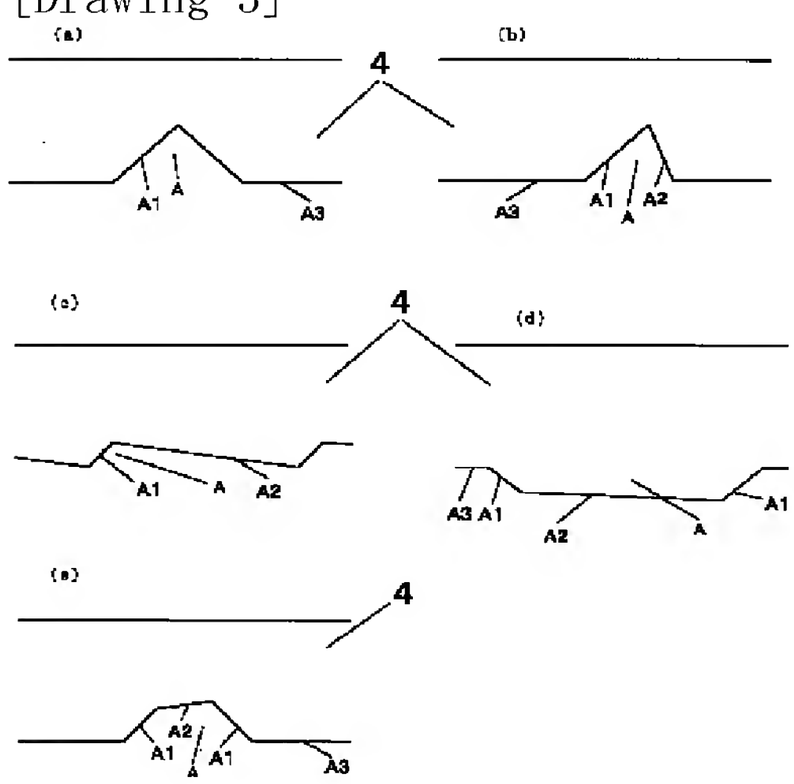
[Drawing 1]



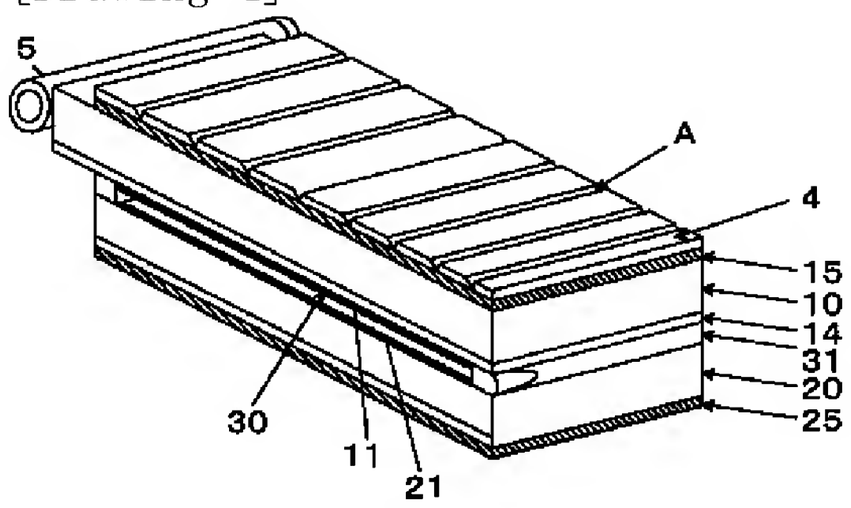
[Drawing 2]



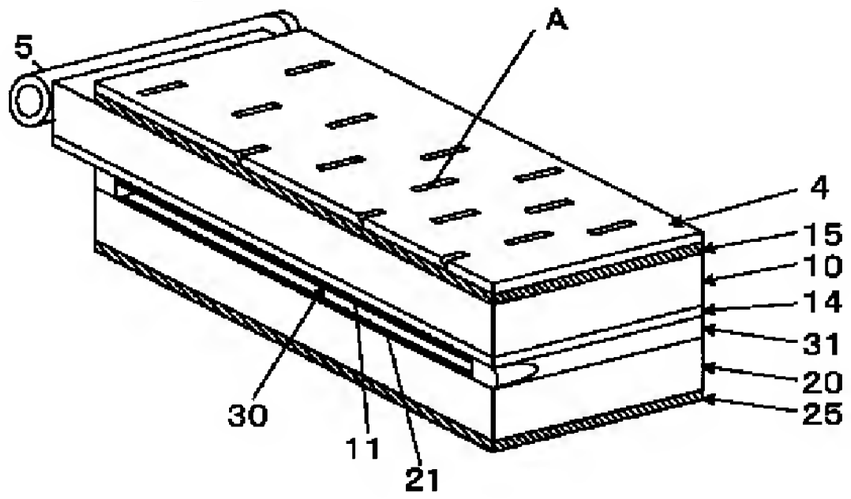
[Drawing 3]



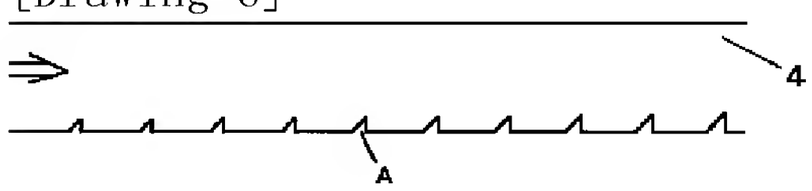
[Drawing 4]



[Drawing 5]



[Drawing 6]



[Drawing 7]

[Translation done.]

(19)日本国特許庁（ＪＰ）　(12)**公開特許公報**（Ａ）　(11)特許出願公開番号
特開2003－66443
（P2003－66443A）
(43)公開日　平成15年３月５日(2003.3.5)

(51)Int.Cl.[7]		識別記号	FI		テーマコード(参考)
Ｇ０２Ｆ	1/13357		Ｇ０２Ｆ 1/13357		２Ｈ０４２
Ｆ２１Ｖ	8/00	６０１	Ｆ２１Ｖ 8/00	６０１Ｃ	２Ｈ０９１
Ｇ０２Ｂ	5/02		Ｇ０２Ｂ 5/02	Ｃ	５Ｃ０９４
Ｇ０２Ｆ	1/1335	５２０	Ｇ０２Ｆ 1/1335	５２０	５Ｇ４３５
Ｇ０９Ｆ	9/00	３２４	Ｇ０９Ｆ 9/00	３２４	

審査請求　未請求　請求項の数23　ＯＬ　（全 13 頁）　最終頁に続く

(21)出願番号　特願2001－251282(P2001－251282)

(22)出願日　平成13年８月22日(2001.8.22)

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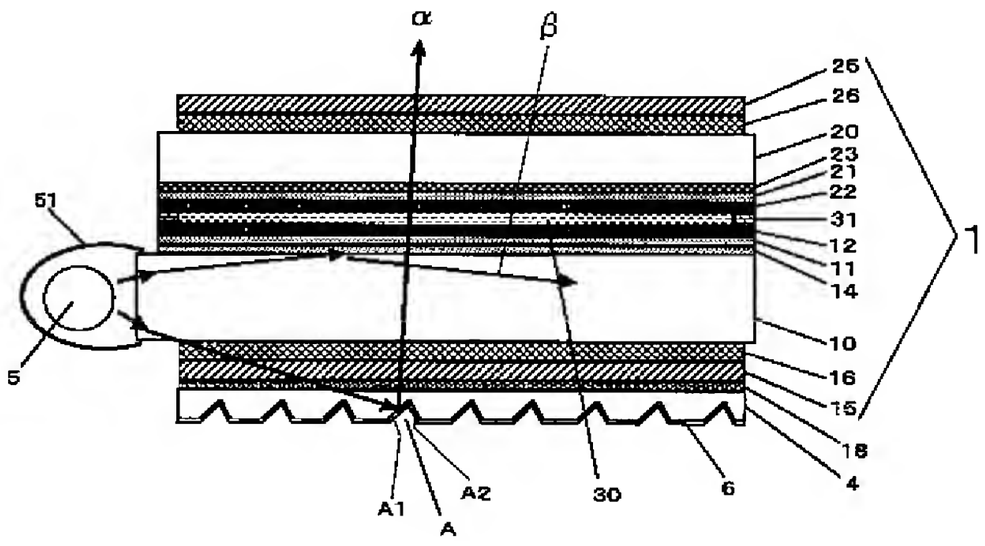
最終頁に続く

(54)【発明の名称】　液晶表示装置

(57)【要約】
【課題】サイドライト型導光板では達成が困難な薄型軽量化を実現でき、表示品位も良好な半透過反射層具備の照明・外光両用型の液晶表示装置の開発。
【解決手段】透明基板（１０）にその基板よりも低屈折率の透明層（１４）、及び光を透過しかつ反射する半透過反射層（１１）を少なくとも有する背面側基板と、透明基板（２０）に透明電極（２１）を有する視認側基板とを、それらの電極側を対向させて配置した間に液晶（３０）を挟持してなる液晶セルを少なくとも具備する液晶表示パネル（１）における１又は２以上の側面に照明装置（５）を有し、かつ前記背面側基板の外側にその基板の基準平面に対する傾斜角が３５～４８度の光路変換斜面（Ａ１）の複数を有すると共に、前記低屈折率の透明層よりも屈折率が高い光路制御層（４）を設けてなる液晶表示装置。



【特許請求の範囲】
【請求項１】　透明基板にその基板よりも低屈折率の透明層、及び光を透過しかつ反射する半透過反射層を少なくとも有する背面側基板と、透明基板に透明電極を有する視認側基板とを、それらの電極側を対向させて配置した間に液晶を挟持してなる液晶セルを少なくとも具備する液晶表示パネルにおける１又は２以上の側面に照明装置を有し、かつ前記背面側基板の外側にその基板の基準平面に対する傾斜角が３５～４８度の光路変換斜面の複数を有すると共に、前記低屈折率の透明層よりも屈折率が高い光路制御層を設けてなることを特徴とする液晶表示装置。
【請求項２】　請求項１において、低屈折率の透明層が透明基板と半透過反射層の間に位置し、その半透過反射層が電極を兼ねる液晶表示装置。
【請求項３】　請求項１において、背面側基板を形成する透明基板の上に低屈折率の透明層を介して凹凸式光散乱面を有する半透過反射層を有し、かつその半透過反射層の上に表面平滑な透明絶縁層を介して透明電極を有する液晶表示装置。
【請求項４】　請求項１～３において、光路制御層の外側に光反射層を有する液晶表示装置。
【請求項５】　請求項４において、光反射層が少なくとも金属薄膜を有するものである液晶表示装置。
【請求項６】　請求項５において、光反射層が少なくとも透明フィルムに金属薄膜を設けたものからなり、その光反射層が光路制御層よりも小さい屈折率の接着手段で光路制御層に接着されてなる液晶表示装置。
【請求項７】　請求項１～６において、背面側基板を形成する透明基板と低屈折率の透明層との屈折率差が０．０５以上である液晶表示装置。
【請求項８】　請求項１～７において、液晶セルの少なくとも背面側基板を形成する透明基板が光学的に等方性の材料からなる液晶表示装置。
【請求項９】　請求項１～８において、液晶表示パネルが液晶セルの片側又は両側に偏光板を有する液晶表示装置。
【請求項１０】　請求項９において、液晶表示パネルが液晶セルと偏光板の間に１層又は２層以上の位相差板を有する液晶表示装置。
【請求項１１】　請求項１～１０において、光路制御層が照明装置と対面する状態の光路変換斜面を具備するプリズム状凹凸の複数からなる液晶表示装置。
【請求項１２】　請求項１１において、光路制御層のプリズム状凹凸が横断面三角形の凹部からなる液晶表示装置。
【請求項１３】　請求項１２において、プリズム状凹部が照明装置を配置した液晶表示パネルの側面に平行な又は傾斜した稜線方向で光路制御層の一端から他端にわたる連続溝からなる液晶表示装置。
【請求項１４】　請求項１２において、プリズム状凹部が不連続溝からなり、その溝の長さが深さの５倍以上である液晶表示装置。
【請求項１５】　請求項１４において、プリズム状凹部の不連続溝の長さ方向が照明装置を配置した液晶表示パネルの側面と平行又は傾斜した状態にある液晶表示装置。
【請求項１６】　請求項１１において、液晶表示パネルが対向する２側面に照明装置を有してなり、光路制御層のプリズム状凹凸がその照明装置と対面する光路変換斜面を２面有する横断面三角形又は横断面四角形の凹部又は凸部からなる液晶表示装置。
【請求項１７】　請求項１～１６において、光路制御層における光路変換斜面の当該傾斜角が３８～４５度である液晶表示装置。
【請求項１８】　請求項１～１７において、光路制御層が透明シートからなり、それが当該低屈折率の透明層よりも高い屈折率の接着層を介し液晶表示パネルに接着されてなる液晶表示装置。
【請求項１９】　請求項１８において、接着層が粘着層からなる液晶表示装置。
【請求項２０】　請求項１～１９において、光路制御層及び接着層の屈折率が当該低屈折率の透明層よりも０．０５以上高いものである液晶表示装置。
【請求項２１】　請求項１～２０において、視認側基板が形成する側面よりも背面側基板の形成する側面が突出し、照明装置がその背面側基板の突出側面に対し配置されてなる液晶表示装置。
【請求項２２】　請求項１～２１において、照明装置が光反射型の光源ホルダにて包囲され、かつその光源ホルダの端部を介し背面側基板の上下面の端部に接着する方式で背面側基板の側面に配置保持されてなる液晶表示装置。
【請求項２３】　請求項１～２２において、低屈折率の透明層と半透過反射層の間に、液晶駆動用の回路が形成されてなる液晶表示装置。
【発明の詳細な説明】
【０００１】
【発明の技術分野】本発明は、薄型軽量化が容易な表示品位に優れる照明・外光両用型の液晶表示装置に関する。
【０００２】
【発明の背景】ハーフミラー等の半透過反射層を内蔵する照明・外光両用型の液晶表示装置が携帯パソコンや携帯電話等の携帯型機器などとして広く普及している。斯かる携帯型機器では、その携帯性を更に高めるため小型化や薄型化等による軽量化が強く求められている。しかしながら照明モードでの視認を可能とするバックライトに例え従来では薄さに優れるサイドライト式導光板を用いても、その厚さが普通２㎜以上の厚さとなり、装置全

体の薄型軽量化がほぼ限界となっている実状である。
【０００３】
【発明の技術的課題】本発明は、サイドライト型導光板では達成が困難な薄型軽量化を実現でき、表示品位も良好な半透過反射層具備の照明・外光両用型の液晶表示装置の開発を課題とする。
【０００４】
【課題の解決手段】本発明は、透明基板にその基板よりも低屈折率の透明層、及び光を透過しかつ反射する半透過反射層を少なくとも有する背面側基板と、透明基板に透明電極を有する視認側基板とを、それらの電極側を対向させて配置した間に液晶を挟持してなる液晶セルを少なくとも具備する液晶表示パネルにおける１又は２以上の側面に照明装置を有し、かつ前記背面側基板の外側にその基板の基準平面に対する傾斜角が３５～４８度の光路変換斜面の複数を有すると共に、前記低屈折率の透明層よりも屈折率が高い光路制御層を設けてなることを特徴とする液晶表示装置を提供するものである。
【０００５】
【発明の効果】本発明によれば、照明装置の側面配置と薄さに優れる光路制御層にてバックライト機構を形成でき、液晶セル基板、特にその背面側基板を利用してパネル側面に配置した照明装置からの入射光を対向の側面方向に効率よく伝送しつつ、その伝送光を背面側に配置の光路制御層を介し液晶表示パネルの視認側に効率よく光路変換して照明モードの液晶表示に利用でき、また半透過反射層を介し外光モードでの液晶表示も達成できて、薄さと軽量性に優れ、明るくて表示品位に優れる照明・外光両用型の液晶表示装置を得ることができる。
【０００６】前記は、背面側基板に設けた低屈折率の透明層、斜面反射式の光路制御層、及び半透過反射層を用いたことによる。すなわち低屈折率の透明層に基づく全反射による閉じ込め効果でパネル側面からの入射光を対向の側面方向に効率よく伝送できて、画面全体での明るさの均一性が向上し良好な表示品位が達成される。低屈折率の透明層がないと後方への伝送効率に乏しくて照明装置から遠離るほど画面が暗くなり見づらい表示となる。
【０００７】一方、光路制御層によりその光路変換斜面を介し側面からの入射光ないしその伝送光を反射させて指向性よく光路変換でき、薄型化も達成することができる。粗面等を介した散乱反射方式では前記指向性の達成は困難である。また光路制御層と液晶表示パネルとを組合せたことにより、従来のサイドライト式導光板では達成が困難な極めて薄い光出射手段とすることができる。ちなみに２００μm以下、就中１００μm以下の光路制御層の形成も可能である。
【０００８】他方、半透過反射層の使用により、その透過率と反射率をバランスさせて照明モードと外光モードの両方において明るさに優れる液晶表示を達成することができる。
【０００９】
【発明の実施形態】本発明による液晶表示装置は、透明基板にその基板よりも低屈折率の透明層、及び光を透過しかつ反射する半透過反射層を少なくとも有する背面側基板と、透明基板に透明電極を有する視認側基板とを、それらの電極側を対向させて配置した間に液晶を挟持してなる液晶セルを少なくとも具備する液晶表示パネルにおける１又は２以上の側面に照明装置を有し、かつ前記背面側基板の外側にその基板の基準平面に対する傾斜角が３５～４８度の光路変換斜面の複数を有すると共に、前記低屈折率の透明層よりも屈折率が高い光路制御層を設けてなるものである。
【００１０】前記した液晶表示装置の例を図１、図２に示した。１が液晶表示パネル、４が光路制御層で、Ａ１が光路変換斜面、１０が背面側の透明基板で、１１、１１ｂが電極を兼ねることもある半透過反射層、１４が低屈折率の透明層、２０が視認側の透明基板、２１が透明電極、３０が液晶、５、５２が照明装置である。なお１２、２２は配向膜、１５、２５は偏光板、１６、２６は位相差板、２３はカラーフィルタ、６は光反射層である。
【００１１】液晶表示パネル１としては、図例の如く透明基板１０にその基板よりも低屈折率の透明層１４及び光を透過しかつ反射する半透過反射層１１を少なくとも有する背面側基板（１０）と、透明基板２０に透明電極２１を有する視認側基板（２０）とをそれらの電極１１、２１の側を対向させて配置した間に液晶３０を挟持してなる液晶セルを少なくとも具備して、光路制御層４を配置した背面側からの入射光を液晶等による制御を介し表示光として他方の視認側より出射する適宜なものを用いることができ、その種類について特に限定はない。なお図中の３１は、透明基板１０、２０の間に液晶３０を封入するためのシール材である。
【００１２】ちなみに前記した液晶セルの具体例としては、液晶の配向形態に基づいてＴＮ液晶セルやＳＴＮ液晶セル、垂直配向セルやＨＡＮセル、ＯＣＢセルの如きツイスト系や非ツイスト系、ゲストホスト系や強誘電性液晶系のもの、光拡散を利用したものなどがあげられ、液晶の駆動方式も例えばアクティブマトリクス方式やパッシブマトリクス方式などの適宜なものであってよい。
【００１３】背面側や視認側のセル基板には照明光や表示光の透過を可能とするため透明基板が用いられる。その透明基板は、ガラスや樹脂などの適宜な材料で形成でき就中、複屈折を可及的に抑制して光損失を低減する点などより光学的に等方性の材料からなるものが好ましい。また輝度や表示品位の向上等の点より青ガラス板に対する無アルカリガラス板の如く無色透明性に優れるものが好ましく、さらに軽量性等の点よりは樹脂基板が好ましい。

【００１４】背面側基板に設ける低屈折率の透明層は、その背面側基板を形成する透明基板よりも屈折率の低い層として設けることで図１に折れ線矢印βとして示した如く、照明装置５からの入射光が背面側基板１０の内部を伝送される際にその伝送光を基板１０と透明層１４との屈折率差を介し全反射させて背面側基板内に効率よく閉じ込め、それにより前記伝送光を対向の側面側（後方）に効率よく伝送して照明装置から遠い位置における光路制御層４の光路変換斜面Ａ１にも伝送光を均等性よく供給し、その斜面による反射を介し折れ線矢印αとして示した如く光路変換して表示画面全体における明るさの均一性の向上を目的とする。

【００１５】また前記した低屈折率の透明層は、前記の伝送光が液晶層に入射して複屈折や散乱を受け、それにより伝送状態が部分的に変化して伝送光が減少したり不均一化することを防止して表示が暗くなることや、照明装置近傍での表示が後方においてゴースト化して表示品位を低下させることの防止なども目的とする。さらにカラーフィルタ等を配置した場合にそれによる伝送光の吸収による急激な減衰を防止して伝送光の減少を回避することも目的とする。照明装置からの入射光が液晶層内を伝送されるものでは液晶層で伝送光が散乱されて不均一な伝送状態となり、出射光の不均一化やゴーストを生じて表示像が見ずらくなりやすい。

【００１６】低屈折率の透明層は、背面側基板を形成する透明基板よりも屈折率の低い例えば無機系や有機系の低屈折率誘電体の如き適宜な材料を用いて真空蒸着方式やスピンコート方式などの適宜な方式で形成することができ、その材料や形成方法について特に限定はない。前記した全反射による後方への伝送効率等の点より透明層と透明基板の屈折率差は、大きいほど有利であり、就中０．０５以上、特に０．１～０．４であることが好ましい。かかる程度の屈折率差では外光モードによる表示品位に殆ど影響しない。ちなみに当該屈折率差が０．１の場合、その界面での外光の反射率は０．１％以下でありその反射損による明るさやコントラストの低下は極めて小さいものである。

【００１７】低屈折率の透明層の配置位置は適宜に決定しうるが、前記した伝送光の閉じ込め効果や液晶層への浸入防止などの点より図例の如く透明基板１０と半透過反射層１１の間に位置させることが好ましい。また透明基板１０と半透過反射層１１の間にカラーフィルタを配置する場合には、カラーフィルタによる伝送光の吸収損を防止する点よりそのカラーフィルタよりも基板１０側に位置させることが好ましい。従って通例、低屈折率の透明層１４は背面側基板１０に直接設けられる。その場合、基板における透明層の付設面は平滑なほど、よって透明層は平滑なほど伝送光の散乱防止に有利で好ましく、また表示光への影響防止の点よりも好ましい。なお前記の点より通例の場合、図１の例の如くカラーフィルタ２３は、視認側基板２０の側に位置させることが好ましい。

【００１８】低屈折率の透明層の厚さは、薄すぎると波動のしみだし現象で上記した閉じ込め効果に薄れる場合があることより全反射効果の維持の点より厚いほど有利である。その厚さは全反射効果等の点より適宜に決定しうるが一般には波長３８０～７８０nmの可視光に対する、特に短波長側の波長３８０nmの光に対する全反射効果等の点より、屈折率×層厚で算出される光路長に基づいて１／４波長（９５nm）以上、就中１／２波長（１９０nm）以上、特に１波長（３８０nm）以上の厚さであることが好ましく、さらには６００nm以上の厚さであることが好ましい。

【００１９】背面側や視認側のセル基板１０、２０の厚さについては、特に限定はなく液晶の封入強度などに応じて適宜に決定しうる。一般には光伝送効率と薄型軽量性のバランスなどの点より１０μm～５mm、就中５０μm～２mm、特に１００μm～１mmの厚さとされる。特に上記した如く背面側基板を照明装置からの入射光の伝送基板として用いる場合には入射効率や伝送効率等の点より横断面積が大きいほど有利であり、従って厚いほど好ましい。一方、視認側基板は薄型軽量化の点より薄いほど有利である。よって背面側と視認側の透明基板の厚さは、同じであってもよいし、相違していてもよい。なお透明基板は同厚板であってもよいし、特に背面側基板は光路制御層の傾斜配置による光路変換斜面への伝送光の入射効率の向上を目的に横断面楔形の如く厚さが部分的に相違するものであってもよい。

【００２０】また背面側と視認側の透明基板は、平面寸法が同じであってもよいし、相違していてもよい。背面側基板を照明装置からの入射光の伝送基板として用いる場合には図例の如く少なくとも照明装置５、５２を配置する側の側面において、視認側基板２０が形成する側面よりも背面側基板１０の形成する側面が突出する状態にあることが、その突出側面に照明装置を配置した場合の入射効率等の点より好ましい。

【００２１】半透過反射層は、照明モード時のバックライト光を透過させ、かつ外光モード時に入射外光を反射させることを目的とし、これにより照明・外光両用型のものを実現することができる。半透過反射層は、例えばハーフミラーや開口を設けた反射層の如く光を透過し、かつ反射する適宜な層として形成することができる。就中、ハーフミラーの如き金属薄膜や開口を設けた金属層が液晶セル内での機能維持性などの点より好ましい。

【００２２】半透過反射層における光の透過率と反射率の割合は、照明モード時のバックライト光の明るさと外光モード時の明るさのバランスなどにより適宜に決定することができる。一般には透過率に基づいて５～９５％、就中１５～８５％、特に２５～７５％とされる。ちなみに前記したハーフミラー方式では、その膜厚を制御

することにより、開口方式ではその開口の占有率を制御することにより光の透過率と反射率の割合を変えることができる。

【００２３】なお半透過反射層を前記した開口方式で形成する場合、液晶セルにおける画素サイズの５～９５％、就中１５～８５％、特に２５～７５％の大きさの開口を画素の配置に可及的に対応させて分布させることが表示画面での明るさの均一性を高める点より好ましい。開口を有する半透過反射層は、打ち抜き方式やエッチング方式、所定の開口を設けたマスクを介して蒸着する方式などの適宜な方式で形成することができる。

【００２４】半透過反射層は、外光の利用効率向上の点よりに凹凸表面にて入射外光を散乱反射するように形成されていることが好ましい。半透過反射層が金属箔の如き厚膜からなる場合には例えば、その表面をバフ処理等の粗面化方式で処理する方法にても凹凸式光散乱面を形成することができる。

【００２５】一方、蒸着方式等による薄膜からなる半透過反射層の場合には例えば、透明基板の表面を凹凸式光散乱面としてその凹凸が反映した薄膜を形成する方式などにより入射外光を散乱反射させうる半透過反射層を形成することができる。その際、上記した低屈折率透明層の平滑性を維持する点よりは、表面平滑な透明基板を用いて低屈折率透明層を設け、その上に表面凹凸構造の層を設けることが好ましい。

【００２６】前記した後者の方式の場合には、半透過反射層の表裏面が散乱反射面となるため表示品位を向上させうる利点がある。すなわち照明モードにおいて基板内部の伝送光が半透過反射層に到達したときに、その裏面で散乱反射されて伝送距離が短くなる。また半透過反射層を透過した伝送光もその殆どが、視認側基板内部に閉じ込められて出射防止されたり、液晶層やカラーフィルター層等による吸収や位相差発生などの影響で出射防止されたりする。

【００２７】前記の結果、半透過反射層や駆動回路による吸収で伝送光が急激に減少することを抑制できる。また半透過反射層の透過に基づく液晶層の複屈折や光散乱に基づく部分的な変化による伝送光の減少や不均一性の発生で表示が暗くなること、光源側に近い部分での表示が後方で影響するゴースト現象が発生することを抑制することができる。開口式の半透過反射層の場合も同様である。

【００２８】半透過反射層は、液晶駆動用の回路を形成する電極を兼ねるものとして設けるができる。図１がその例を示している。また半透過反射層とは別体のものとして液晶駆動用の回路を形成する透明電極を設けるができる。図２がその例を示している。特に図２では、上記した凹凸式光散乱面を有する透明基板１０を用いた場合の例を示している。この場合には透明電極が凹凸化しないことが好ましいことより、半透過反射層１１ｂの上にレベリングを目的とした表面平滑な透明絶縁層１１ｃを設け、その上に透明電極１１ｄが形成されている。その透明絶縁層は、例えば透明樹脂の塗工層などの適宜な方式で形成することができる。また液晶表示装置は、低屈折率の透明層と半透過反射層の間に、液晶駆動用の回路を設けたものとして形成することもできる。

【００２９】視認側の透明基板、及び必要に応じて背面側の透明基板に設ける透明電極は、例えばＩＴＯ等の従来に準じた適宜な材料にて形成することができる。液晶セルの形成に際しては必要に応じ、液晶を配向させるためのラビング処理膜等からなる配向膜やカラー表示のためのカラーフィルタなどの適宜な機能層の１層又は２層以上を設けることができる。なお図例の如く、配向膜１２、２２は通常、電極１１、１１ｂ、２１の上に形成され、またカラーフィルタ２３は通常、セル基板１０、２０の一方における透明基板と電極の間に設けられる。なお図例では視認側基板２０にカラーフィルタ２３が設けられている。

【００３０】液晶表示パネルは、図１、図２の例の如く液晶セルに偏光板１５、２５や位相差板１６、２６、光拡散層等の適宜な光学層の１層又は２層以上を必要に応じて付加したものであってもよい。偏光板は直線偏光を利用した表示の達成を目的とし、位相差板は液晶の複屈折性による位相差の補償等による表示品位の向上などを目的とする。また光拡散層は、表示光の拡散による表示範囲の拡大や光路制御層の光路変換斜面を介した輝線状発光の平準化による輝度の均一化、液晶表示パネル内の伝送光の拡散による光路制御層への入射光量の増大などを目的とし、光路制御層４と視認側の偏光板２５の間の適宜な位置に１層又は２層以上を配置することができる。

【００３１】前記の偏光板としては、適宜なものを用いることができ特に限定はない。高度な直線偏光の入射による良好なコントラスト比の表示を得る点などよりは、例えばポリビニルアルコール系フィルムや部分ホルマール化ポリビニルアルコール系フィルム、エチレン・酢酸ビニル共重合体系部分ケン化フィルムの如き親水性高分子フィルムにヨウ素や二色性染料等の二色性物質を吸着させて延伸したものからなる吸収型偏光フィルムやその片側又は両側に透明保護層を設けたものなどの如く偏光度の高いものが好ましく用いうる。

【００３２】前記透明保護層の形成には、透明性や機械的強度、熱安定性や水分遮蔽性などに優れるものが好ましく用いられ、その例としてはアセテート系樹脂やポリエステル系樹脂、ポリエーテルスルホン系樹脂やポリカーボネート系樹脂、ポリアミド系樹脂やポリイミド系樹脂、ポリオレフィン系樹脂やアクリル系樹脂、ポリエーテル系樹脂やポリ塩化ビニル、スチレン系樹脂やノルボルネン系樹脂の如きポリマー、あるいはアクリル系やウレタン系、アクリルウレタン系やエポキシ系、シリコー

ン系等の熱硬化型ないし紫外線硬化型の樹脂などがあげられる。
【００３３】透明保護層は、フィルムとしたものの接着方式やポリマー液等の塗布方式などにより付与することができる。従って斯かる透明保護層の形成技術は、上記した透明絶縁層の形成に適用することもできる。
【００３４】用いる偏光板、特に視認側の偏光板は、外光の表面反射による視認阻害の防止を目的にノングレア処理や反射防止処理を施したものであってもよい。ノングレア処理は、サンドブラスト方式やエンボス加工方式等の粗面化方式、シリカ等の透明粒子の配合方式や透明粒子を配合した樹脂の塗工方式などの種々の方式で表面を微細凹凸構造化することにより施すことができ、反射防止処理は、干渉性の蒸着膜を形成する方式などにて施すことができる。
【００３５】またノングレア処理や反射防止処理は、前記の表面微細凹凸構造や干渉膜を付与したフィルムの接着方式などにても施すことができる。なお偏光板は、図例の如く液晶セルの両側に設けることもできるし、液晶セルの片側にのみ設けることもできる。また前記した表面微細凹凸構造化技術は、上記した半透過反射層又は／及び透明基板の表面を凹凸式光散乱面とする場合に適用することができる。
【００３６】一方、位相差板としても例えば前記の透明保護層で例示したものなどの適宜なポリマーからなるフィルムを一軸や二軸等の適宜な方式で延伸処理してなる複屈折性フィルム、ネマチック系やディスコティック系等の適宜な液晶ポリマーの配向フィルムやその配向層を透明基材で支持したものなどの適宜なものを用いることができる。熱収縮性フィルムの加熱収縮力の作用下に厚さ方向の屈折率を制御したものなどであってもよい。
【００３７】補償用の位相差板１６、２６は通例、図例の如く視認側又は／及び背面側の偏光板１５、２５と液晶セルの間に必要に応じて配置され、その位相差板には波長域などに応じて適宜なものを用いうる。また位相差板は、位相差等の光学特性の制御を目的に２層以上を重畳して用いることもできる。
【００３８】また光拡散層についても前記のノングレア層に準じた表面微細凹凸構造を有する塗工層や拡散シートなどによる適宜な方式にて設けることができる。光拡散層は、透明粒子配合の粘着層として偏光板や位相差板の接着を兼ねる層として形成することもでき、それにより薄型化を図ることもできる。その粘着層の形成には、ゴム系やアクリル系、ビニルアルキルエーテル系やシリコーン系、ポリエステル系やポリウレタン系、ポリエーテル系やポリアミド系、スチレン系などの適宜なポリマーをベースポリマーとする粘着剤などを用いうる。
【００３９】就中アクリル酸ないしメタクリル酸のアルキルエステルを主体とするポリマーをベースポリマーとするアクリル系粘着剤の如く透明性や耐候性や耐熱性などに優れるものが好ましく用いられる。また粘着層に配合することのある前記の透明粒子としては、例えば平均粒径が０．５～２０μmのシリカやアルミナ、チタニアやジルコニア、酸化錫や酸化インジウム、酸化カドミウムや酸化アンチモン等からなる導電性のこともある無機系粒子、架橋又は未架橋のポリマー等からなる有機系粒子などの適宜なものを１種又は２種用いることができる。斯かる透明粒子は、上記したノングレア処理等にも用いることができる。
【００４０】液晶表示パネルの側面に配置する照明装置は、液晶表示装置の照明光として利用する光を液晶表示パネルの側面から入射させることを目的とする。これによりパネル背面に配置する光路制御層との組合せにて液晶表示装置の薄型軽量化を図ることができる。照明装置からの入射光の液晶層への入射を防止する点より照明装置の好ましい配置方式は、上記した図例の如く背面側基板の側面、特に視認側基板が形成する側面よりも突出させた背面側基板の側面に対して配置する方式である。
【００４１】照明装置としては適宜なものを用いることができ、例えば（冷，熱）陰極管等の線状光源、発光ダイオード等の点光源やそれを線状や面状等に配列したアレイ体、あるいは点光源と線状導光板を組合せて点光源からの入射光を線状導光板を介し線状光源に変換するようにした照明装置などが好ましく用いうる。
【００４２】図１、２の例の如く照明装置５、５２は、液晶表示パネルにおける１又は２以上の側面に配置することができる。照明装置を２以上の側面に配置する場合、その複数の側面は図２の例の如く対向する側面の組合せであってもよいし、縦横に交差する側面の組合せであってもよく、それらを併用した３側面以上の組合せであってもよい。
【００４３】照明装置は、その点灯による照明モードでの視認を可能とするものである。照明・外光両用型では外光による外光モードにて視認するときには点灯の必要がないので、その点灯・消灯を切り替えうるものとされる。その切り替え方式には任意な方式を採ることができ、従来方式のいずれも採ることができる。なお照明装置は、発光色を切り替えうる異色発光式のものであってもよく、また異種の照明装置を介して異色発光させうるものとすることもできる。
【００４４】図例の如く照明装置５、５２に対しては、必要に応じ発散光を液晶表示パネルの側面に導くためにそれを包囲する光源ホルダ５１などの適宜な補助手段を配置した組合せ体とすることもできる。光源ホルダとしては、例えば高反射率の金属薄膜を付設した樹脂シートや白色シート、金属箔や樹脂成形品などの如く、少なくとも照明装置側が光を反射する適宜な反射シートを用いうる。光源ホルダは、その端部を液晶表示パネルのセル基板、特に背面側基板の上下面の端部に接着する方式などにて照明装置の包囲を兼ねる保持手段として利用する

こともできる。
【００４５】光路制御層は、図１に矢印αで示した如く液晶表示パネル１の側面に配置した照明装置５からの入射光ないしその伝送光を光路変換斜面Ａ１を介し当該パネルの視認側に光路変換させて照明光（表示光）として利用することを目的とし、液晶表示パネル１の背面側基板１０の外側に配置される。
【００４６】前記の目的より光路制御層４は、図１、２の例の如く照明装置５、５２からの入射光を反射して所定方向に光路変換するために、背面側基板の基準平面（仮想水平面）に対する傾斜角が３５～４８度の光路変換斜面Ａ１を有するものとされる。また光路制御層は、薄型化を目的に前記光路変換斜面の複数を有するものとされる。さらに光路制御層は、背面側基板に設けた低屈折率の透明層よりも屈折率の高い層として形成される。光路制御層の屈折率が当該透明層のそれよりも低いと照明装置からの入射光ないしその伝送光が背面側基板内に閉じ込められやすくて光路制御層への入射が阻害され表示光として利用しにくくなる。
【００４７】光路制御層は、前記した所定の光路変換斜面の複数を有するものとする点を除き、適宜な形態のものとして形成することができる。光路変換等を介して正面方向への指向性に優れる表示光を得る点よりは、照明装置を配置した側面すなわち入射側面と対面する光路変換斜面Ａ１を具備する光出射手段Ａの複数を有する光路制御層、特にプリズム状凸凹からなる光路変換斜面Ａ１を具備する光出射手段Ａの複数を有する光路制御層が好ましい。
【００４８】前記した光路変換斜面ないしプリズム状凸凹を有する光出射手段の例を図３（ａ）～（ｅ）に示した。その（ａ）～（ｃ）では光出射手段Ａが横断面三角形のものからなり、（ｄ）、（ｅ）では横断面四角形のものからなる。また（ａ）では二等辺三角形による２面の光路変換斜面Ａ１を有し、（ｂ）では光路変換斜面Ａ１と基準平面に対する傾斜角が斜面Ａ１よりも大きい急斜面Ａ２を有する光出射手段Ａを有するものからなる。
【００４９】（ｃ）では光路変換斜面Ａ１と基準平面に対する傾斜角が小さい緩斜面Ａ２とを単位とする光出射手段Ａが隣接連続状態で光路制御層片側の全面に形成されたものからなり、（ｄ）では凸部（突起）からなる光出射手段Ａを、（ｅ）では凹部（溝）からなる光出射手段Ａを有するものからなる。
【００５０】従って前記した例のように光出射手段は、等辺面ないし同じ傾斜角の斜面からなる凸部又は凹部にても形成できるし、光路変換斜面と急斜面又は緩斜面ないし傾斜角が相違する斜面からなる凸部又は凹部にても形成でき、その斜面形態は入射側面の数や位置に応じて適宜に決定することができる。耐擦傷性の向上による斜面機能の維持の点よりは、凸部よりも凹部からなる光出射手段として形成されていることが斜面等が傷付きにくくて有利である。
【００５１】上記した正面方向への指向性等の特性を達成する点などより好ましい光路制御層は、図例の如く基準平面に対する傾斜角が３５～４８度の光路変換斜面Ａ１を入射側面に対面して有するものである。従って液晶表示パネルの２側面以上に照明装置を配置して２以上の入射側面を有する場合には、その数と位置に対応して光路変換斜面Ａ１を有する光路制御層としたものが好ましく用いられる。
【００５２】ちなみに図２の例の如く液晶表示パネル１の対向する２側面に照明装置５、５２を配置する場合には、図３（ａ）の如き横断面二等辺三角形からなる光出射手段Ａによる２面の光路変換斜面Ａ１や、図３（ｄ）、（ｅ）の如き横断面台形からなる光出射手段Ａによる２面の光路変換斜面Ａ１をその稜線が入射側面に沿う方向となる状態で有する光路制御層４が好ましく用いられる。
【００５３】また液晶表示パネルの縦横で隣接する２側面に照明装置を配置する場合には、その側面に対応して稜線が縦横の両方向に沿う状態で光路変換斜面Ａ１を有する光路制御層が好ましく用いられる。さらには対向及び縦横を含む３側面以上に照明装置を配置する場合には、前記の組合せからなる光路変換斜面Ａ１を有する光路制御層が好ましく用いられる。
【００５４】前記した光路変換斜面Ａ１は、照明装置を介した入射側面よりの入射光ないしその伝送光の内、その面Ａ１に入射する光を反射して光路変換し液晶表示パネルの視認側に供給する役割をする。その場合、光路変換斜面Ａ１の基準平面に対する傾斜角を３５～４８度とすることにより図１に折線矢印αで例示した如く、側面入射光ないしその伝送光を基準平面に対し垂直性よく光路変換して正面への指向性に優れる表示光を効率よく得ることができる。
【００５５】光路変換斜面の傾斜角が３５度未満では反射光の光路が正面方向より大きくずれて表示に有効利用しにくく正面方向の輝度に乏しくなり、４８度を超えると側面入射光ないしその伝送光を全反射させる条件から外れて光路変換斜面よりの漏れ光が多くなり側面入射光の光利用効率に乏しくなる。
【００５６】正面への指向性に優れる光路変換や漏れ光の抑制等の点より光路変換斜面Ａ１の好ましい傾斜角は、液晶表示パネル内を伝送される光のスネルの法則による屈折に基づく全反射条件などを考慮して３８～４５度、就中４０～４４度である。ちなみにガラス板の一般的な全反射条件は約４２度であり従ってその場合、側面入射光は±４２度の範囲に集約された状態で伝送されつつ、光路変換斜面に入射することとなる。
【００５７】光路変換斜面Ａ１を具備する光出射手段Ａは、上記のように光路制御層の薄型化を目的に図４、５に例示の如く複数が設けられる。その場合、入射側面か

らの入射光を後方に反射し対向側面側に効率よく伝送して液晶表示全面で可及的に均一に発光させる点よりは、基準平面に対する傾斜角が１０度以下、就中５度以下、特に３度以下の緩斜面Ａ２ないし当該傾斜角が略０度の平坦面Ａ３を含む構造とすることが好ましい。従って図３（ｂ）に例示の急斜面Ａ２を含む光出射手段Ａでは、その急斜面の角度を３５度以上、就中５０度以上、特に６０度以上として平坦面Ａ３の幅を広くできる構造とすることが好ましい。

【００５８】光出射手段Ａは、図４、５に例示の如くその稜線が照明装置５を配置した液晶表示パネル１の入射側面に平行又は傾斜状態で沿うように設けられるがその場合、光出射手段Ａは図４の如く光路制御層の一端から他端にわたり連続して形成されていてもよいし、図５の如く断続的に不連続に形成されていてもよい。不連続に形成する場合、伝送光の入射効率や光路変換効率などの点よりその溝又は突起からなる凹凸の入射側面に沿う方向の長さを深さ又は高さの５倍以上とすることが好ましく、またパネル表示面の均一発光化の点より前記長さを５００μm以下、就中１０～４８０μm、特に５０～４５０μmとすることが好ましい。なお図４、５では半透過反射層を省略している。

【００５９】光出射手段Ａの横断面形状やそれを介した光路変換斜面Ａ１のピッチについては特に限定はない。光路変換斜面Ａ１が照明モードでの輝度決定要因となることよりパネル表示面における発光の均一性などに応じて適宜に決定でき、その分布密度にて光路変換光量を制御することができる。従って斜面Ａ１、２の傾斜角等が光路制御層の全面で一定な形状であってもよいし、吸収ロスや先の光路変換による伝送光の減衰に対処してパネル表示面の発光の均一化を図ることを目的に図６に例示の如く入射側面から遠離るほど光出射手段Ａを大きくしてもよい。

【００６０】また図６に例示の如く一定ピッチの光出射手段Ａとすることもできるし、図７に例示の如く入射側面から遠離るほど徐々にピッチを狭くして光出射手段Ａの分布密度を多くしたものとすることもできる。さらにランダムピッチにてパネル表示面における発光の均一化を図ることもできる。

【００６１】加えて光出射手段Ａが不連続な溝又は突起からなる凹凸の場合には、その凹凸の大きさや形状、分布密度や稜線の方向等を不規則なものとしたり、その不規則な又は規則的ないし画一的な凹凸をランダムに配置してパネル表示面における発光の均一化を図ることもできる。よって前記した例の如くパネル表示面での発光の均一化は、光出射手段Ａに適宜な方式を適用して達成することができる。なお図６、７において矢印方向が入射側面からの入射光の伝送方向である。

【００６２】光路変換斜面は、上記のように側面入射光の光路変換による実質的な照明光形成の機能部分であるから、その間隔が広すぎると点灯時の照明が疎となって不自然な表示となる場合がある。その防止の点より、光路変換斜面Ａ１のピッチは、２㎜以下、就中２０μm～１㎜、特に５０μm～０．５㎜とすることが好ましい。

【００６３】一方、複数の光路変換斜面、特に入射側面方向に連続した光路変換斜面を介した照明光が液晶セルの画素と干渉してモアレを生じる場合がある。モアレの防止は、光路変換斜面のピッチ調節で行いうるが、そのピッチには前記のように好ましい範囲がある。従って前記の好ましいピッチ範囲でモアレが生じる場合の解決策が問題となる。

【００６４】前記の場合、画素に対して光路変換斜面が交差状態で配列しうるように凹凸の稜線を入射側面に対し傾斜する状態に形成してモアレを防止する方式が好ましい。その場合、入射側面に対する傾斜角が大きすぎると光路変換斜面を介した反射に偏向を生じて光路変換の方向に大きな偏りが発生し表示品位の低下原因となりやすいことから、その稜線の入射側面に対する傾斜角は、±３０度以内、就中±２５度以内とすることが好ましい。なお、±の符号は入射側面を基準とした稜線の傾斜方向を意味する。液晶セルの解像度が低くてモアレを生じない場合やモアレを無視しうる場合には、かかる稜線は入射側面に平行なほど好ましい。

【００６５】前記の点より液晶セルの画素ピッチが一般に１００～３００μmであることも考慮して光路変換斜面は、その基準平面に対する投影幅に基づいて４０μm以下、就中３～２０μm、特に5～１５μmとなるように形成することが好ましい。かかる投影幅は、一般に蛍光管のコヒーレント長が２０μm程度とされている点などより回折による表示品位の低下を防止する点よりも好ましい。

【００６６】光路制御層は、照明装置の波長域に応じそれに透明性を示し、かつ上記低屈折率の透明層よりも高屈折率の適宜な材料にて形成しうる。ちなみに可視光域では、上記の透明保護層等で例示したポリマーないし硬化型樹脂やガラスなどがあげられる。複屈折を示さないか、複屈折の小さい材料で形成した光路制御層が好ましい。

【００６７】また界面反射でパネル内部に閉じ込められて出射できない損失光量を抑制し、側面入射光ないしその伝送光を光路制御層、特にその光路変換斜面に効率よく供給する点より上記低屈折率の透明層よりも屈折率が０．０５以上、就中０．０８以上、特に０．１～０．４高い光路制御層であることが好ましい。さらに照明装置からの入射光ないしその伝送光を背面側基板から光路制御層に効率よく入射させて光路変換斜面を介し明るい表示を達成する点より、背面側基板との屈折率差が０．１５以内、就中０．１０以内、特に０．０５以内の光路制御層であること、殊に当該透明基板よりも高い屈折率の光路制御層であることが好ましい。

【００６８】光路制御層は、切削法にても形成でき適宜な方法で形成することができる。量産性等の点より好ましい製造方法としては、例えば熱可塑性樹脂を所定の形状を形成しうる金型に加熱下に押付て形状を転写する方法、加熱溶融させた熱可塑性樹脂あるいは熱や溶媒を介して流動化させた樹脂を所定の形状に成形しうる金型に充填する方法、熱や紫外線ないし放射線等で重合処理しうるモノマーやオリゴマーや液状樹脂を所定の形状を形成しうる型に充填ないし流延して重合処理する方法があげられる。

【００６９】また支持フィルムに予め紫外線ないし放射線等で重合処理しうる前記の液状樹脂等を塗工し、その塗工層を所定の形状を形成しうる型で成形して重合処理する方法などもあげられる。その場合、透明な支持フィルムを用いてそのフィルムと一体化した光路制御層を形成することもできるし、形成後に支持フィルムと剥離して当該塗工層に基づく成形層のみからなる光路制御層を形成することもできる。その場合には透明フィルムである必要はない。剥離は、支持フィルムを剥離剤で表面処理する方法などにより達成することができる。

【００７０】従って光路制御層は、背面側基板等に直接その所定形態を付与して形成することもできるし、所定の形態を付与した透明シート等として形成することもできる。光路制御層の厚さは、適宜に決定しうるが一般には薄型化などの点より３００μm以下、就中５～２００μm、特に１０～１００μmとされる。なお光出射手段の横断面に基づく三～五角形等の形状は、厳密な多角形を意味するものではなく製造技術等に基づく角部の丸みや面の歪みなどが許容されるものである。

【００７１】光路制御層は、液晶表示パネルの背面側に配置されるがその場合、図１、２に例示の如くその斜面形成面すなわち光出射手段Ａを形成した面を外側（背面側）にして配置することが、光出射手段Ａの光路変換斜面Ａ１を介した反射効率、ひいては側面入射光の有効利用による輝度向上の点などより好ましい。

【００７２】光路制御層を前記の如く透明シート等として独立に形成した場合には、図例の如くその透明シート等を上記した低屈折率の透明層１４よりも高い屈折率の接着層１８、就中その透明シート等と可及的に等しい屈折率の接着層、特にその透明シート等と背面側基板との中間の屈折率の接着層を介して液晶表示パネルに接着することが前記の点などより好ましい。

【００７３】従って前記接着層の屈折率は、上記した光路制御層に準じうる。よって光路制御層と接着層の屈折率は、低屈折率の透明層よりも０．０５以上高いことが好ましい。接着層は、適宜な透明接着剤にて形成でき、その接着剤の種類について特に限定はない。接着処理作業の簡便性などの点よりは粘着層による接着方式が好ましい。その粘着層については上記に準じることができ、上記した光拡散型の粘着層とすることもできる。

【００７４】図例の如く、光路制御層４の背面側（外側）には必要に応じて光反射層６を配置することもできる。斯かる光反射層は、光路制御層を介した反射光が液晶セル内部の半透過反射層にて反射反転されられて出射できなくなることを、再度その光反射層で反射反転させて液晶セル方向に戻して光の利用効率、ひいては輝度を向上させることを目的とする。また外光モードにおいても半透過反射層を透過した外光を反射反転させて液晶セル方向に戻し光の利用効率、ひいては輝度の向上に有効である。さらに光路制御層よりの漏れ光を反射反転させて再入射させることによる光利用効率の向上にも有効である。

【００７５】光反射層は、従来に準じた白色シートなどの適宜なものにて形成することができる。就中、例えばアルミニウムや銀、金や銅やクロム等の高反射率の金属ないしその合金の粉末をバインダ樹脂中に含有させた塗工層、前記の金属等や誘電体多層膜を真空蒸着方式やスパッタリング方式等の適宜な薄膜形成方式で付設してなる金属薄膜層、前記の塗工層や付設層をフィルム等からなる基材で支持した反射シート、金属箔などからなる高反射率の光反射層、特に少なくとも金属薄膜を有する光反射層が反射効率等の点より好ましい。なお斯かる光反射層の形成技術は、上記した半透過反射層の形成に適用することができる。

【００７６】光反射層は、図１の例の如く光路制御層の裏面に密着付設されていてもよい。斯かる光反射層６の形成は、光路制御層に対して例えば金属薄膜を真空蒸着する方式や、金属薄膜を蒸着した柔軟な反射シートを接着層を介して接着する方式などにより行うことができる。後者の場合、接着層の屈折率は光路制御層よりも小さいことが、伝送光を界面の屈折率差に基づく全反射で効率的に伝送できて好ましい。

【００７７】また光反射層は、図２の例の如く光路制御層の光出射手段とは離れて光路制御層の裏面に密着する状態、さらにはその裏面よりも離れた状態で設けることもできる。その光反射層には高反射率の金属シートや高反射率の金属薄膜を設けた反射シート、さらには発泡プラスチックフィルムなどの白色フィルムなどが好ましく用いられる。ちなみに図２の例では光反射層６ｂが透明な支持基材６ａに付設した金属薄膜からなり、それが光利用効率の向上を目的に光路制御層４よりも低屈折率の接着層６ｃを介して接着されている。

【００７８】光反射層は、鏡面であってもよいが、モアレ防止の観点よりは光拡散機能を示すものが好ましい。前記の如く光反射層は、光路制御層の外側に単に重ね置いた状態にあってもよいし、接着方式や蒸着方式などで密着配置された状態にあってもよい。図１の例の如く光出射手段の斜面に光反射層を密着配置した場合には、反射効果の向上で漏れ光をほぼ完全に防止でき視角特性や輝度をより向上させうる利点などもある。

【００７９】前記した光拡散型の反射層の形成は、例えばサンドブラストやマット処理等による表面の粗面化方式や、粒子添加方式などの適宜な方式で表面を微細凹凸構造としたフィルム基材等にその微細凹凸構造を反映させた光反射層を設ける方式などにより行うことができる。その表面の微細凹凸構造を反映させた微細凹凸構造の光反射層の形成は、例えば真空蒸着方式やイオンプレーティング方式、スパッタリング方式等の蒸着方式やメッキ方式などの適宜な方式で金属をフィルム基材等の表面に付設する方法などにより行うことができる。斯かる光拡散型の反射層の形成技術は、上記した半透過反射層の形成に適用することができる。

【００８０】本発明による液晶表示装置によれば、照明モードにおいて入射側面よりの入射光の殆どが液晶表示パネル、特にその背面側基板を介し屈折の法則による反射を介して後方に伝送されパネル表面よりの出射（漏れ）が防止されつつ、光路制御層の光路変換斜面Ａ１に入射した光が効率よく視認方向に垂直指向性よく光路変換され、他の伝送光も全反射にて後方にさらに伝送されて後方における光路変換斜面Ａ１に入射し効率よく視認方向に垂直指向性よく光路変換される。

【００８１】次に前記の光路変換斜面で光路変換された光は、半透過反射層に到達しそれを透過した光が液晶セルに入射して表示光が形成され、パネル表示面の全面において明るさの均一性に優れる表示を達成することができる。一方、外光モードでは視認側より入射した外光が半透過反射層に到達しそれで反射された光が液晶セルで表示光とされて、パネル表示面の全面において明るさの均一性に優れる表示を達成することができる。

【００８２】光路制御層の外側に光反射層を設けた場合には、上記の如く光利用効率が向上して明るさがより向上する。従って照明装置からの光を効率よく利用して明るくて見やすく表示品位に優れる照明・外光両用型の液晶表示装置を形成することができる。

【００８３】なお本発明において上記した液晶表示装置を形成する光路制御層や液晶セル、偏光板や位相差板等の光学素子ないし部品は、全体的又は部分的に積層一体化されて固着されていてもよいし、分離容易な状態に配置されていてもよい。界面反射の抑制によるコントラストの低下防止などの点よりは固着状態にあることが好ましい。その固着密着処理には、粘着剤等の適宜な透明接着剤を用いることができ、その透明接着層に上記した透明粒子等を含有させて拡散機能を示す接着層などとすることもできる。

【００８４】また前記の光学素子ないし部品、特に視認側のそれには例えばサリチル酸エステル系化合物やベンゾフェノン系化合物、ベンゾトリアゾール系化合物やシアノアクリレート系化合物、ニッケル錯塩系化合物等の紫外線吸収剤で処理する方式などにより紫外線吸収能をもたせることもできる。

【００８５】

【実施例】参考例１

厚さ０．７㎜、屈折率１．５２の無アルカリガラス板にフッ化マグネシウムを真空蒸着して厚さ６００㎚、屈折率１．３８の低屈折率透明層を形成し、その上に表面微細凹凸構造の樹脂層を設けた。次にその上にアルミニウムを真空蒸着し、エッチング方式で２５０μm角の開口を２０％の開口率で均等に分布するように形成して電極を兼ねる半透過反射層を設け、その上にポリビニルアルコール溶液をスピンコートしてその乾燥膜をラビング処理して背面側基板を得た。一方、前記と同様の無アルカリガラス板にＩＴＯ透明導電層を形成しその透明電極をエッチングして分割した後、その上にラビング処理膜を設けて視認側基板を得た。

【００８６】ついで前記の背面側基板と視認側基板をそのラビング面をラビング方向が直交するように対向させてギャップ調節材を配し、周囲をエポキシ樹脂でシールしたのち液晶（メルク社製、ＺＬＩ－４７９２）を注入してＴＮ系液晶セルを形成し、その両面に位相差板付き偏光板を貼着してノーマリーホワイトの液晶パネルを得た。そのパネルサイズは、幅２５㎜、長さ３４㎜で、その長さ方向の背面側基板の一側面が背面側基板よりも２㎜突出したものである。次にその背面側基板の突出側面に冷陰極管を配置し、銀蒸着のポリエステルフィルムで包囲してフィルム端部を基板の上下面に両面粘着テープで接着し冷陰極管を保持固定した。

【００８７】参考例２

背面側基板にフッ化マグネシウムからなる低屈折率透明層を設けないほかは参考例１に準じて両側面に冷陰極管を保持させたノーマリーホワイトの液晶パネルを得た。

【００８８】参考例３

予め所定形状に加工した金型にアクリル系の紫外線硬化型樹脂（東亞合成社製、アロニックスＵＶ－３７０１）をスポイトにて滴下充填し、その上に厚さ６０μmのポリカーボネート（ＰＣ）フィルムを静置しゴムローラで密着させて余分な樹脂と気泡を除去しメタルハライドランプにて紫外線を照射して硬化処理した後、金型から剥離し所定寸法に裁断してＰＣフィルムを剥離し、屈折率１．５１の光路制御層（透明シート）を得、その光路制御層を有しない面に屈折率１．５１のアクリル系粘着層を付設した。

【００８９】なお前記の透明シートは、幅２２㎜、長さ２８㎜であり、稜線が幅方向にわたり２１度の角度で傾斜するプリズム状凹部を１９０μmのピッチで連続して有し、その光路変換斜面の傾斜角が４２度で急斜面Ａ２との頂角が７０度であり（図３ｂ）、光路変換斜面の基準平面に対する投影幅が７～１２μmで、平坦部（Ａ３）の面積が光路変換斜面と急斜面の基準平面に対する投影合計面積の１０倍以上のものからなる。

【００９０】参考例４

異なる金型を用いて参考例３に準じ粘着層付の透明シートを得た。この透明シートは、傾斜角が約４２度で基準平面に対する投影幅が１０μｍの光路変換斜面Ａ１と傾斜角が約７５度の急斜面Ａ２からなる長さ８０μｍの光出射手段（図３ｂ）をその長さ方向が入射側面に平行な状態で有し、かつその光出射手段を長さ方向の入射側面より遠離るほど徐々に高密度に配置したものであり（図５、図７）、平坦部（Ａ３）の面積は、光路変換斜面と急斜面の基準平面に対する投影合計面積の１０倍以上である。

【００９１】参考例５

サンドブラストにて表面を粗面化加工した金型を用いたほかは参考例３に準じ粘着層付の透明シートを得た。

【００９２】参考例６

異なる金型を用いて参考例３に準じ粘着層付の透明シートを得た。この透明シートは、プリズム状凹部を１９０μｍのピッチで連続して有し（図３ｂ）、その光路変換斜面Ａ１の傾斜角が３０度で急斜面Ａ２との頂角が７０度、光路変換斜面の基準平面に対する投影幅が７～１２μｍで、平坦部（Ａ３）の面積が光路変換斜面と急斜面の基準平面に対する投影合計面積の１０倍以上のものからなる。

【００９３】参考例７

参考例３に準じて形成した光路制御層の光出射手段形成面にアルミニウムを真空蒸着して光反射層を設けた透明シートを得た。

【００９４】参考例８

透明なプラスチックフィルムの表面にアルミニウムを真空蒸着して光反射シートを得た。

【００９５】参考例９

透明なプラスチックフィルムの表面にアルミニウムを真空蒸着し、その上に屈折率１．４１の粘着層を形成して光反射シートを得た。

【００９６】実施例１

参考例１の液晶パネルの背面側に参考例３の透明シートをその粘着層を介して接着し、その背面側に参考例８の光反射シートを周辺のみ粘着層を介し接着して液晶表示装置を得た。

【００９７】実施例２

参考例１の液晶パネルの背面側に参考例３の透明シートをその粘着層を介して接着し、その背面側に参考例９の光反射シートを粘着層を介し接着して液晶表示装置を得た。

【００９８】実施例３

参考例１の液晶パネルの背面側に参考例４の透明シートをその粘着層を介して接着し、その背面側に参考例８の光反射シートを周辺のみ粘着層を介し接着して液晶表示装置を得た。

【００９９】実施例４

参考例１の液晶パネルの背面側に参考例７の透明シートをその粘着層を介し接着して液晶表示装置を得た。

【０１００】比較例１

参考例２の液晶パネルの背面側に参考例３の透明シートをその粘着層を介し接着し、その背面側に参考例８の光反射シートを周辺のみ粘着層を介し接着して液晶表示装置を得た。

【０１０１】比較例２

参考例２の液晶パネルの背面側に参考例３の透明シートをその粘着層を介し接着し、その背面側に参考例９の光反射シートを粘着層を介し接着して液晶表示装置を得た。

【０１０２】比較例３

参考例１の液晶パネルの背面側に参考例５の透明シートをその粘着層を介し接着し、その背面側に参考例８の光反射シートを周辺のみ粘着層を介し接着して液晶表示装置を得た。

【０１０３】比較例４

参考例１の液晶パネルの背面側に参考例６の透明シートをその粘着層を介し接着し、その背面側に参考例８の光反射シートを周辺のみ粘着層を介し接着して液晶表示装置を得た。

【０１０４】評価試験

実施例、比較例で得た液晶表示装置について、暗室にて液晶セルに電圧を印加しない状態で冷陰極管を点灯させ、中央位置での正面輝度を輝度計（トプコン社製、ＢＭ７）にて調べた。また入射側面端、中央部及び対向端で照明モードによる表示を観察した場合の表示品位を評価した。評価は、明るくてその均一性に優れ良好に光が出射している場合を○、明るさやその均一性にやや劣る場合△、暗くて不均一な場合を×とした。

【０１０５】前記の結果を次表に示した。

	正面輝度（cd／m²）	表示品位 入射側面端	中央部	対向端
実施例１	５８	○	○	○
実施例２	４２	○	○	○
実施例３	５１	○	○	○
実施例４	４４	○	○	△
比較例１	２９	○	△	△
比較例２	２５	○	△	×
比較例３	２１	△	△	×

比較例４	１９	△	△	×

【０１０６】表より、実施例では照明モードにおいて明るくて均一な表示が達成されているが、比較例では非常に暗いか不均一な表示であることがわかる。また低屈折率透明層を有する実施例１、２では明るさとその均一性が高いが、低屈折率透明層を有しない比較例１、２では入射側面より遠離るほど急激に暗くなり、半透過反射層の影響と思われる明るさの不均一性の大きいことがわかり、非常に見ずらい表示であった。

【０１０７】また光路制御層を粗面とした比較例３や光路制御層の斜面角度が小さい比較例４では効果的に光出射がなされず暗かった。実施例、比較例のいずれの場合も外光モードでは良好な見え方をしており、低屈折率透明層の影響は全く認められなかった。以上より、本発明により導光板を用いることなく、液晶パネル端面に光源装置を設けるだけで発光可能な、薄くて軽量な照明・外光両用型の液晶表示装置を実現されていることがわかる。

【図面の簡単な説明】

【図１】実施例の説明断面図

【図２】他の実施例の説明断面図

【図３】光路制御層における光出射手段の側面説明図

【図４】さらに他の実施例の斜視説明図

【図５】さらに他の実施例の斜視説明図

【図６】光路制御層例の側面説明図

【図７】他の光路制御層例の側面説明図

【符号の説明】

１：液晶表示パネル

１０、２０：透明基板

１１、１１ｂ：半透過反射層

２１：透明電極

１２、２２：配向膜

１４：低屈折率の透明層

１５、２５：偏光板

１６、２６：位相差板

２３：カラーフィルタ

３０：液晶

４：光路制御層

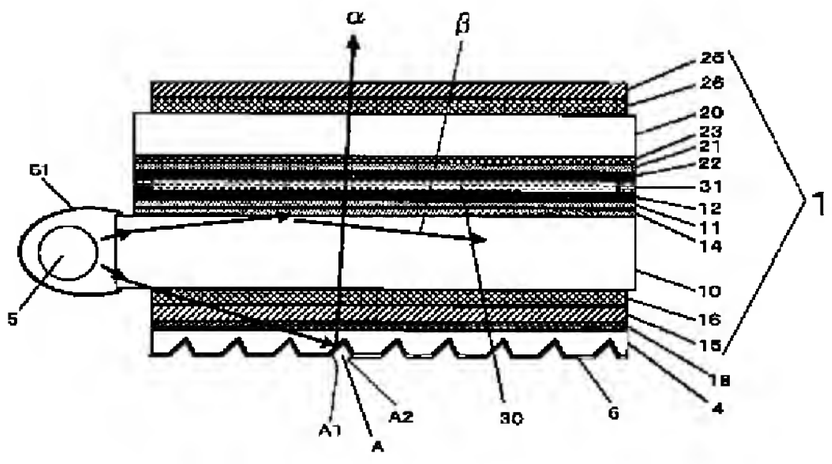
Ａ：光出射手段

Ａ１：光路変換斜面

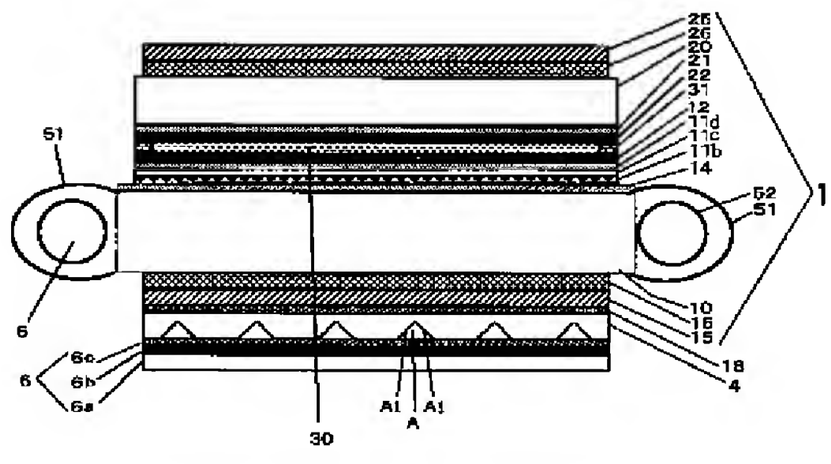
５、５２：照明装置

６：光反射層

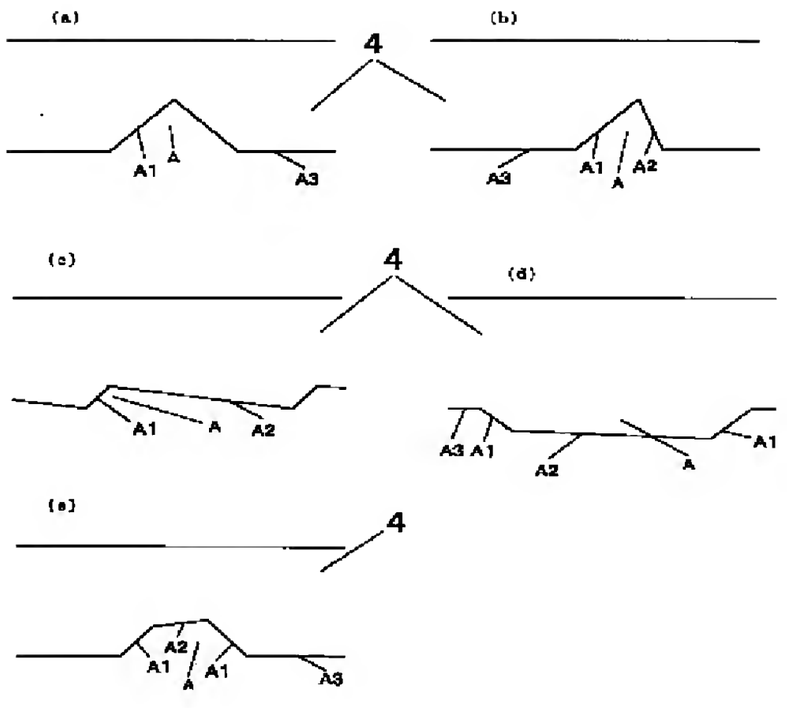
【図１】



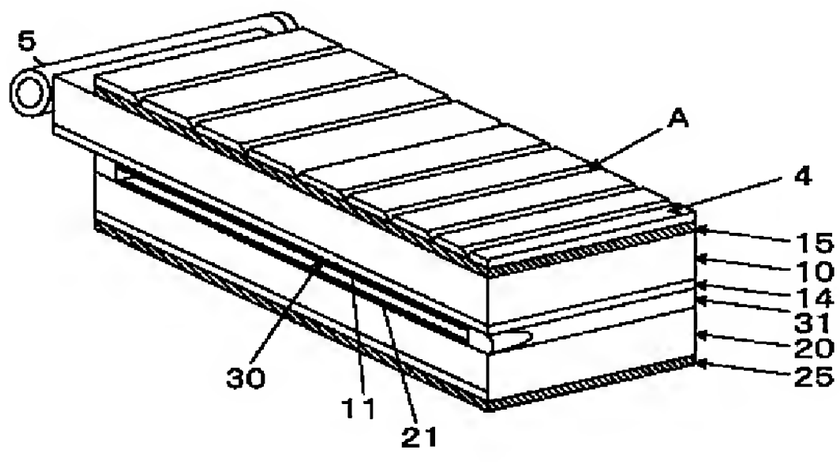
【図２】



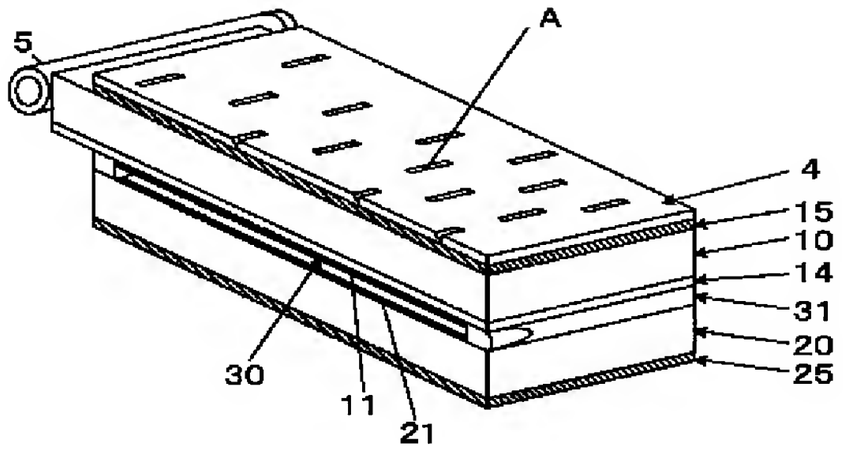
【図３】



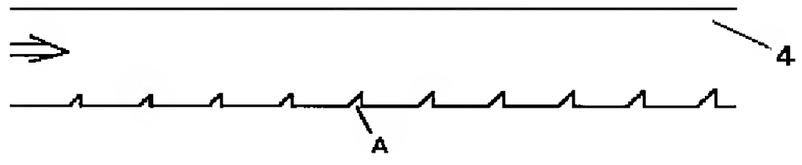
【図４】



【図５】



【図６】



【図７】

フロントページの続き

(51)Int.Cl.[7]		識別記号	FI		テーマコード（参考）
Ｇ０９Ｆ	9/00	３３６	Ｇ０９Ｆ 9/00		３３６Ｃ
					３３６Ｊ
	9/30	３４８		9/30	３４８Ａ
	9/35			9/35	
// Ｆ２１Ｙ	103:00		Ｆ２１Ｙ 103:00		

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Ｆターム(参考)　2H042 BA05 BA14 BA15 BA20
2H091 FA02Y FA08X FA08Z FA11X FA11Z FA14Y FA15Y FA16Y FA41Y FD06 FD14 GA01 GA06 LA11
5C094 AA10 AA15 BA43 DA05 EA05 EB02 ED12 ED13 JA13
5G435 AA03 AA18 BB12 BB15 EE23 EE27 FF03 FF06 FF12